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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

636-235

MAR 2 5 1998
UNIVERSITY OF ILLINOIS
URBANA-CHAMPAIGN

February 1998

The Grizzly

Headquarters, Department of the Army
PB 5-98-1 Approved for public release, distribution is unlimited

CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

A recurring headline in the last few months has concerned an international effort to ban antipersonnel land mines [APLs]. After wading through the half-truths, emotional diatribe, and disparaging remarks made about our President, I want to set the record straight. I will address our policy, our nation's role in demining, and our current mine doctrine.

First our policy, which is very clear: U.S. forces do not use or train with nonself-destructing (NSD) APLs. The only exceptions to this policy are for the defense of Korea and to train demining teams.

Korea is a unique situation. The minefields along the demilitarized zone (DMZ) have helped maintain the peace for 44 years while South Korea has prospered. Poised just 25 miles from the capital of Seoul (the distance from Dallas to Fort Worth) is the vanguard of more than 1 million North Korean soldiers. This army, with more artillery than NATO, has vowed to reunite Korea by force. This is not a hypothetical situation; it is real and it is now. When occupied by the North Koreans in August 1950, thousands of civilians in Seoul vanished. Today, more than 11 million people live in Seoul. In an interview with the Dallas Morning News, published November 23, 1997, our President stated he would not put our military or any South Korean in jeopardy. He does not want one death occurring "...because of a decision I made that seemed compassionate and was popular at the moment and 8 or 9 or 10 years later looked like a terrible mistake."

The world must also consider the second-order effects of removing mines from Korea and how the North Koreans might easily misinterpret our actions. A clear indicator for the Germans of an impending Russian attack during World War II was a buildup of infantry, tanks, artillery, and aircraft and the removal of Russian minefields. North Korea rails against regularly scheduled military maneuvers in the south. What signal will North Korea—a desperate, starving country with an unpredictable government—receive as we compensate for the lack of mines by increasing all our forces in Korea? How will North Korea react if it misinterprets our good intentions for signs of an impending attack? We must leave our mines where they are protecting a fragile peace: harming no one, threatening no one.

Mr. Cornelio Somaruga, president of the International Committee of the Red Cross, stated after the signing of the APL Treaty in Ottawa that "The real victory will come only when all mines have been cleared from battlefields and farm fields." This is *exactly* the problem the world faces. Neither our mines in Korea nor our smart mines stored for combat are the problem. It is the indiscriminate use of APLs in countries such as Cambodia, Afghanistan, and Angola that the world needs to address. The United States leads the world in demining spending and in training deminers. This year we almost tripled our spending effort to nearly $80 million, and next year we will increase that amount to more than $100 million. Many nations have also joined us, including Canada and Norway, by pledging millions for demining.

During the December 2 CNN special program titled "Land Mines: Hidden Assassins," one very committed British deminer, who had been blinded and maimed while demining, commented, "The land-mine ban has not dealt with the problem [human suffering] and will not deal with the problem. The real problem...can only be addressed by clearance." Our Countermine Training Support Center at Fort Leonard Wood is training Special Forces teams to train deminers worldwide. Soon we will train Bosnian deminers in Missouri. Although some have chosen to chide our President for not signing the Ottawa treaty, I agree with the British deminer: Actions speak louder than words.

We have destroyed 2.3 million APLs and soon will destroy another 1 million. In reality, our situational obstacles, which use self-destructing/self-neutralizing mines, give the APL ban advocates exactly what they profess to want:

- They pose no residual threats to civilians.
- They normally are in storage and are used only during intense combat.
- They are not suited for use by guerrilla forces or terrorists.

Some claim that a mine is a mine and that any risk to civilians is unacceptable, but such statements show a basic misunderstanding of our mine doctrine. Self-destructing mines are used to delay and disrupt armored assaults to allow the enemy to be engaged by artillery, tanks, attack helicopters, antitank guided missiles, A-10s, and F-16s. During the four hours the mines are active, there won't be any civilians in this extremely intense environment.

Bottom line: The United States is clearly the world leader for demining activities, and our actions will contribute significantly to ridding the world of NSD mines. As Jan Egeland, the Norwegian Deputy Foreign Minister, recently stated, "In all the countries I have visited to observe the effects of the land-mine plague, I have never encountered an American mine." We are not the problem, but we have the solution.

The next big event at your Engineer Center is the ENFORCE Conference in April, and my staff is busy planning for it. We have reviewed last year's comment sheets and have made adjustments to both improve the conference and meet your needs. My next article will be dedicated to ENFORCE and the engineer vision.

Engineer

February 1998 Headquarters, Department of the Army **Volume 28 PB 5-98-1**

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***Front Cover:** The Grizzly, shown here reducing a wire obstacle, will provide Army engineers with a digitized, situationally aware breaching platform. See article beginning on page 2.*

***Back Cover:** A severe storm on 19-22 June 1944 destroyed the floating pier at Omaha Beach. See article beginning on page 15.*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 370, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 320, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER's e-mail address is: eubanksc@wood.army.mil. Our Internet home page is located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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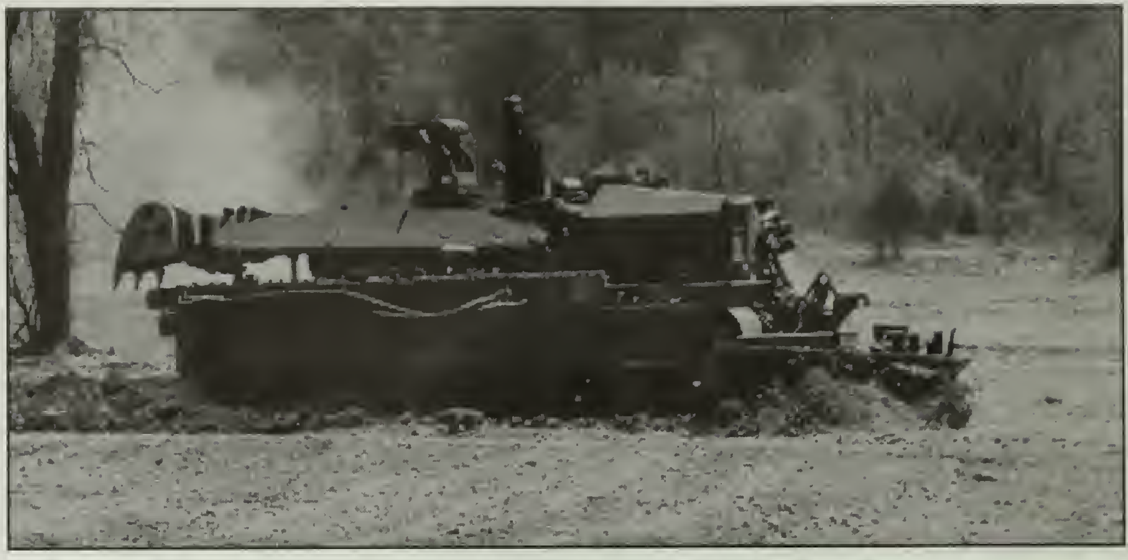


The Grizzly and its companion, the Wolverine heavy assault bridge, will provide engineers digitized, situationally aware breaching platforms. The Engineer School will host a warfighting seminar on 3-4 March 1998 to explore doctrine for digitized breaching operations. A breakout session is planned during the ENFORCE Conference in April to continue the dialogue.

The Grizzly: Mobility Support for Force XXI

By Lieutenant Colonel Donald P. Kotchman, Wesley I. Glasgow, and Lieutenant Colonel Harry Greene

> *"The capability to rapidly breach obstacles has evidenced almost no improvement since World War II. Techniques in use are conceptually the same as those used in the 1940s."*
>
> *Headquarters, U.S. Department of the Army,*
> *After Action Report for Operation Desert Storm, 1991*

Changes are on the horizon. With the fielding of the Grizzly in FY 2004, the U.S. Army will have a survivable, mobile, complex-obstacle-reduction system. These capabilities do not exist in any army today and respond to a growing threat.

The Challenge

As we look to the 21st century and Force XXI operations, our Army expects to have a technological advantage in information and weapons over any potential adversary. To counter our advantages, adversaries will attempt to use asymmetric threats, such as obstacles, which cost little but provide them great benefits.

Obstacles are expected at all levels of conflict, and obstacle technology is improving and proliferating. Rapid ditching machines; artillery-, rocket-, and air-delivered mines; and ground minelayers are available on world markets. They allow our adversaries to rapidly emplace complex obstacles, giving friendly forces little or no warning of their existence. Mine fuzings for hand-emplaced and scatterable mines are moving toward greater sophistication and lethality that overmatch our current reduction assets. A low-cost fuze upgrade to a World War II-era mine (millions of which are available around the world) transforms a simple, pressure-fuzed mine into a full-width, multisensor mine capable of killing our $6 million tanks. We can expect an increase in enemy countermobility operations as a counter to our superiority in information and weapons technology.

> *"Breaching a complex obstacle covered by enemy fire is the toughest attack mission a unit can get."*
>
> *General Frederick Franks Jr. (Retired)*
> *Commander, VII Corps*
> *Operation Desert Storm*

Preparation for breaching operations traditionally includes the following requirements:

- Extensive intelligence.
- Sophisticated preparation of reduction assets brought forward from "one terrain feature back."
- Extensive rehearsals (days, weeks, or even months).
- Massive combat and support preparation.

The complex nature of these requirements necessitates deliberate breaches for all but the most simple obstacles, with a corresponding loss of tempo.

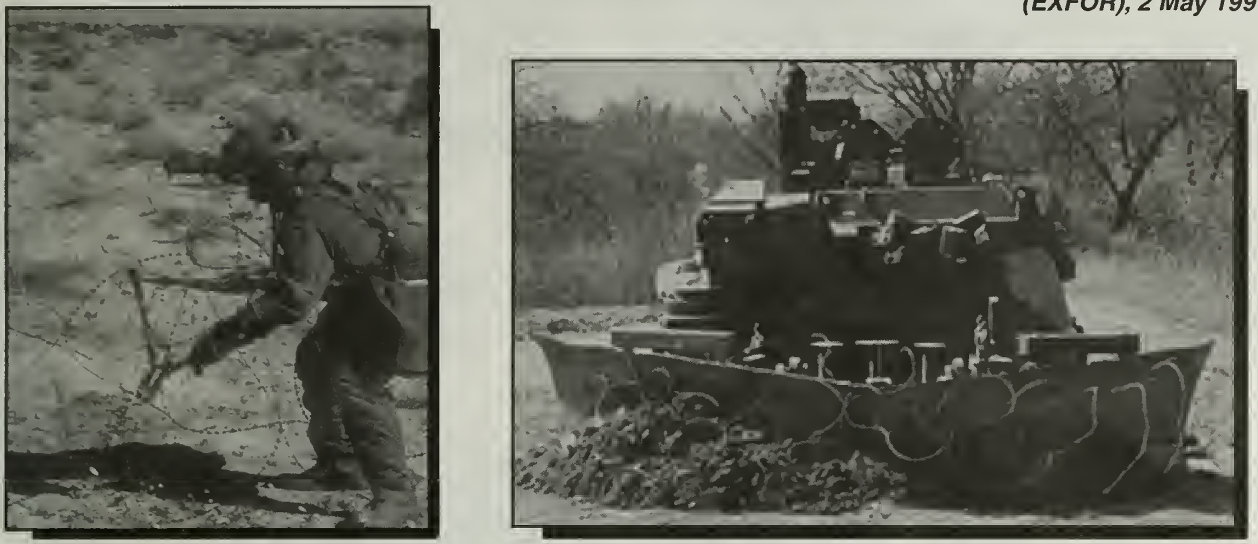
Executing a breach is difficult today due to the large number of vehicles involved and the synchronization required for success. For example, approximately 30 percent of the tank assets in the combined arms battalions of Force XXI will be dedicated to carrying rollers and plows to support breaches. The smaller, more agile units of Force XXI will use information to dominate maneuver. The ability of potential adversaries to rapidly emplace increasingly destructive and effective minefields and complex obstacles mandates new ways to execute breaches to enable dominant maneuver.

Operational Advantage

Today's methods of defeating complex obstacles require a complex operation involving several types of specialized equipment, none of which offer the versatility, mobility, or survivability of the Grizzly. Using

Why Grizzly?

> ***"Got to get a mechanical breach to maintain the tempo on the battlefield...Got to get the soldiers out of harm's way. Grizzly...need it quickly."***
>
> ***MG Paul Kern, CG, 41D (M) (EXFOR), 2 May 1997***



Today **Tomorrow**

Figure 1

current systems, the task force commander and engineer must orchestrate a variety of reduction assets to conduct breaches. Since each complex obstacle is unique, each breach requires employment of the various assets in a different order, effectively preventing the use of battle drills, complicating task organization, and mandating the requirement for lengthy reconnaissance and rehearsals.

Consider a complex obstacle consisting of wire, minefields, and antitank ditches. After completing the preamble to the breach (reconnaissance, planning, assembly of equipment, etc.), the breach begins with removing the wire, typically accomplished by soldiers using wire cutters, bangalore torpedoes, or an M58 mine-clearing line charge (MICLIC). Their efforts may be complicated by antipersonnel mines and fires. After the soldiers create a lane in the wire, they fire a series of MICLICs into the minefield. The number of MICLICs needed depends on the linear depth of the minefield. When the first MICLIC is fired, the breach site is immediately visible to the enemy. After each MICLIC is fired, the lane must be proofed, typically with a mine roller or plow mounted on an M1 tank. Using current allocation rules and the decreased size of the Force XXI combined arms battalion, 30 percent of the combat vehicles are required to push either rollers or plows. The resulting lane is cleared only along the width of the M1 tank tracks, requiring that additional passes or sappers improve the lane for follow-on forces.

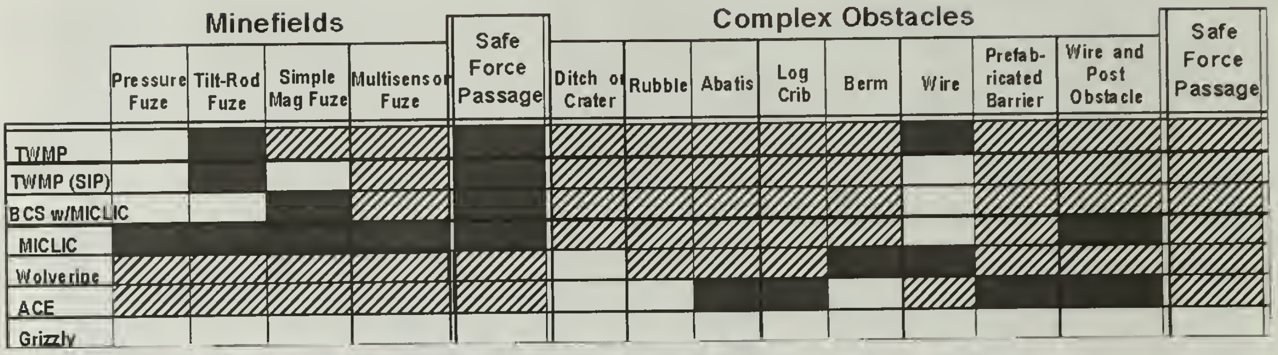
The presence of antitank ditches adds complications since neither tanks equipped with battalion countermine sets nor MICLICs are effective against this obstacle. Either an armored combat earthmover (ACE) or an armored vehicle-launched bridge (AVLB) (Wolverine in the future) must be brought to the lane to breach the ditch. Both the ACE and the AVLB lack the Grizzly's survivability. If more mines are encountered beyond the ditch, additional assets are required to continue the breach. The assault force will be very vulnerable to counterattack until sufficient lanes are created to push additional combat power through the breach. In summary, breaching operations currently require a high degree of coordination, skill, and training on the part of the soldiers attempting to accomplish the mission (Figure 1).

This situation is complicated by emerging full-width, multisensor mine fuzings designed to defeat our current reduction assets. The Grizzly will more easily and rapidly defeat this threat and provide an integrated breach system.

The Solution

The Grizzly promises to greatly improve the effectiveness of our maneuver forces. Under development as a variant of the proven M1 Abrams main battle tank, the Grizzly takes advantage of the M1's mobility and survivability features. With these capabilities, it can maintain the operating tempo of the Bradley- and Abrams-equipped Force XXI combined arms battalions. The Grizzly's integrated system has the capability to reduce all parts of typical obstacles (mines, wire, ditches, rubble, and log obstacles), providing responsive support to the force. The Grizzly incorporates both countermine and counterobstacle capabilities into a single survivable system that, in one pass, creates a lane trafficable

Reducing Complex Obstacles



	Minefields				Safe Force Passage	Complex Obstacles								Safe Force Passage
	Pressure Fuze	Tilt-Rod Fuze	Simple Mag Fuze	Multisensor Fuze		Ditch or Crater	Rubble	Abatis	Log Crib	Berm	Wire	Prefab-ricated Barrier	Wire and Post Obstacle	
TWMP	□	■	▨	▨	■	▨	▨	▨	▨	▨	■	▨	▨	▨
TWMP (SIP)	□	■	□	▨	■	▨	▨	▨	▨	▨	□	▨	▨	▨
BCS w/MICLIC	□	□	■	▨	■	▨	▨	▨	▨	▨	□	▨	▨	▨
MICLIC	■	■	■	■	■	▨	▨	▨	▨	▨	□	▨	■	▨
Wolverine	▨	▨	▨	▨	▨	□	▨	▨	▨	■	■	▨	▨	▨
ACE	▨	▨	▨	▨	▨	□	□	■	■	□	▨	■	■	▨
Grizzly	□	□	□	□	□	□	□	□	□	□	□	□	□	□

Note: 1) *Safe force passage evaluates the system's ability to safely allow follow-on forces and vehicles to pass by guaranteeing the absence of mines in the lane.*

2) *Evaluation does not consider survivability and effectiveness of system or vehicle AFTER a mine blast.*

□ Good Effect

■ Marginal/Conditional Effect

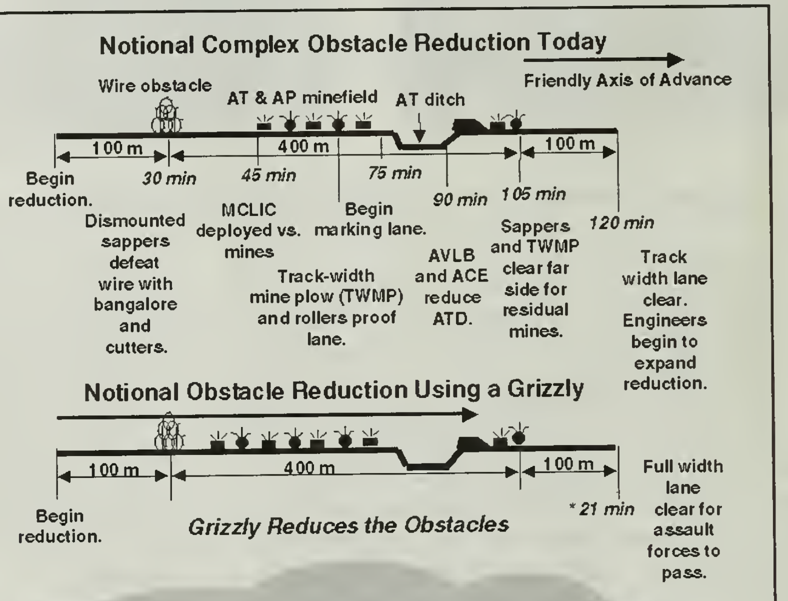
▨ Limited/No Effect

Figure 2

Advantages with Grizzly in Breaching Operations

- Reconnaissance of obstacle can be less detailed because the Grizzly defeats all types of mine fuzings.
- Breach force battle drills will be easier to execute, saving time spent on rehersals.
- Less time will be spent suppressing the enemy, saving lives, ammunition, and equipment.
- Fewer smoke rounds will be expended to obscure reduction sites.
- Time spent reducing complex obstacles is greatly reduced--see drawing.
- Tanks used to push plows and rollers return to the fight.

AT = Antitank
AP = Antipersonnel


Notional Complex Obstacle Reduction Today
Friendly Axis of Advance
Wire obstacle
AT & AP minefield
AT ditch
100 m
400 m
100 m
Begin reduction.
30 min
45 min
75 min
90 min
105 min
120 min
Dismounted sappers defeat wire with bangalore and cutters.
MCLIC deployed vs. mines
Begin marking lane.
Track-width mine plow (TWMP) and rollers proof lane.
AVLB and ACE reduce ATD.
Sappers and TWMP clear far side for residual mines.
Track width lane clear. Engineers begin to expand reduction.
Notional Obstacle Reduction Using a Grizzly
100 m
400 m
100 m
Begin reduction.
Grizzly Reduces the Obstacles
* 21 min
Full width lane clear for assault forces to pass.

Grizzly Increases Tempo
- *Less preparation/rehearsals (saves hours)*
- *Reduces exposure time in the breach*

*Grizzly operational requirement calls for reduction of a 600m obstacle in 21 minutes or less.

Figure 3

by the entire maneuver force. Figure 2 compares the breach capability of current equipment with the Grizzly. Only the Grizzly is effective across the full spectrum of the threat.

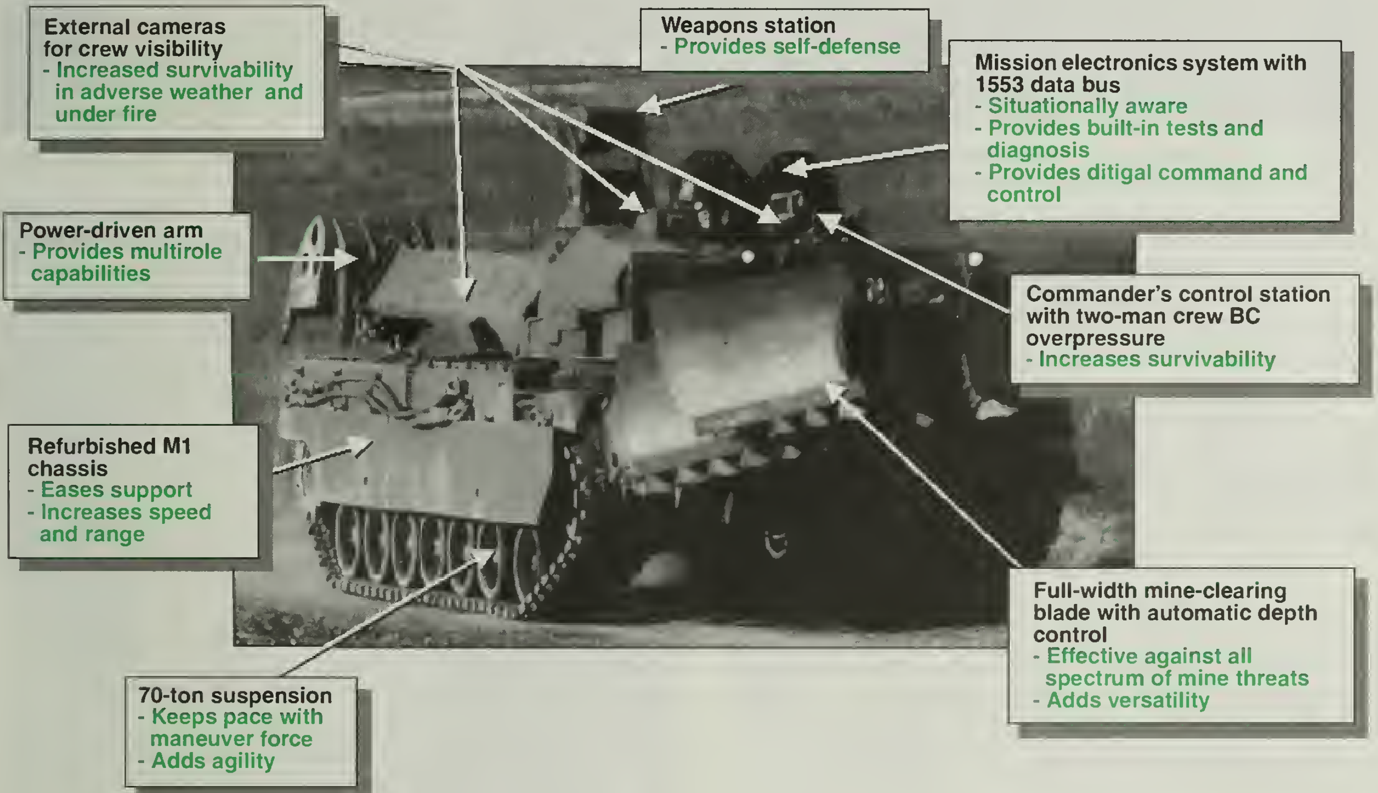
Contrast the previous situation with the same breach conducted by a Grizzly-equipped force. The Grizzly is capable of breaching wire, mines, and ditches; thus, battle drills for the breach are possible. Battle drills eliminate the orchestration of obstacle reduction and ease the battle command challenge. The task force commander can concentrate on suppressing, obscuring, and securing the breach site, leaving obstacle reduction to the engineer and his Grizzly. A Grizzly crew of two can complete a breach that currently requires numerous soldiers in less survivable systems, and the Grizzly allows tanks to fight rather than breach. Perhaps most importantly, the additional tempo provided by the Grizzly allows the assault force to pass combat power sooner than is possible today.

The presence of a rapidly employed, complex obstacle system may be decisive in a battle if it permits adversaries to slow the tempo of our forces. Employing the Grizzly with maneuver task forces allows them to rapidly react to aerial- or artillery-delivered scatterable mines, point obstacles at chokepoints, mechanically emplaced mines, or a combination of these. The Grizzly enables friendly forces to dominate maneuver and strike before the enemy can effectively react. Figure 3 illustrates some of the differences the Grizzly can make to the maneuver force during a breaching operation.

Grizzly Design Characteristics

The Grizzly is a leap ahead in both capabilities provided to the force and in combat vehicle systems. It is a full-tracked, heavily protected vehicle that integrates the following M1 chassis technologies, modernized standard Army components, and Grizzly-unique mission modules:

- M1 chassis with an NBC overpressure system and advanced track and suspension components.
- Standard Army components include the weapons system, digital command and control communications systems, and a wide variety of other standard combat vehicle components, which are integrated in the Grizzly system through an aggressive technology-insertion initiative. This technology-insertion program will ensure the Grizzly remains interoperable with the Bradley and Abrams fleet.
- Grizzly-unique components include a mine-clearing blade with automatic depth control, drive-by-wire operations, a power-driven arm for obstacle reduction and lift, a remotely controlled weapon station, a commander's control station for the organic two-person crew, and a sophisticated vision system for operating the Grizzly "closed hatch."


External cameras for crew visibility
- Increased survivability in adverse weather and under fire
Weapons station
- Provides self-defense
Mission electronics system with 1553 data bus
- Situationally aware
- Provides built-in tests and diagnosis
- Provides ditigal command and control
Power-driven arm
- Provides multirole capabilities
Commander's control station with two-man crew BC overpressure
- Increases survivability
Refurbished M1 chassis
- Eases support
- Increases speed and range
Full-width mine-clearing blade with automatic depth control
- Effective against all spectrum of mine threats
- Adds versatility
70-ton suspension
- Keeps pace with maneuver force
- Adds agility

Key Features

Key to the Grizzly's success is an automatic depth-control system that enables the blade to move at a consistent depth regardless of terrain conditions. This system detects changes in terrain contours and automatically directs hydraulic controllers to adjust blade height, pitch, and roll (angle). Unlike a bulldozer, which provides a final planar surface regardless of the ground contour, the Grizzly blade maintains a constant plow depth while following an undulating surface. The primary system consists of tactile sensor units, which "feel" the surface of the ground. A backup depth-control system is provided by a series of strain gages that measure shear forces on the blade and adjust the depth to maintain a constant force. Manual controls in the crew station provide additional redundancy for depth control. Research continues on sensing technologies for future product improvements.

The mine blade provides a tremendous improvement over the existing mine plow. It is designed to survive mine blasts and retract for road travel while not significantly degrading the mobility of the M1 chassis. The blade incorporates a series of tines (see photo above) that uplift mines onto the dirt spoil moving in front of the blade. The mines are then rolled to the side and deposited with soil astride the cleared lane as the vehicle moves forward. Blade action helps preclude

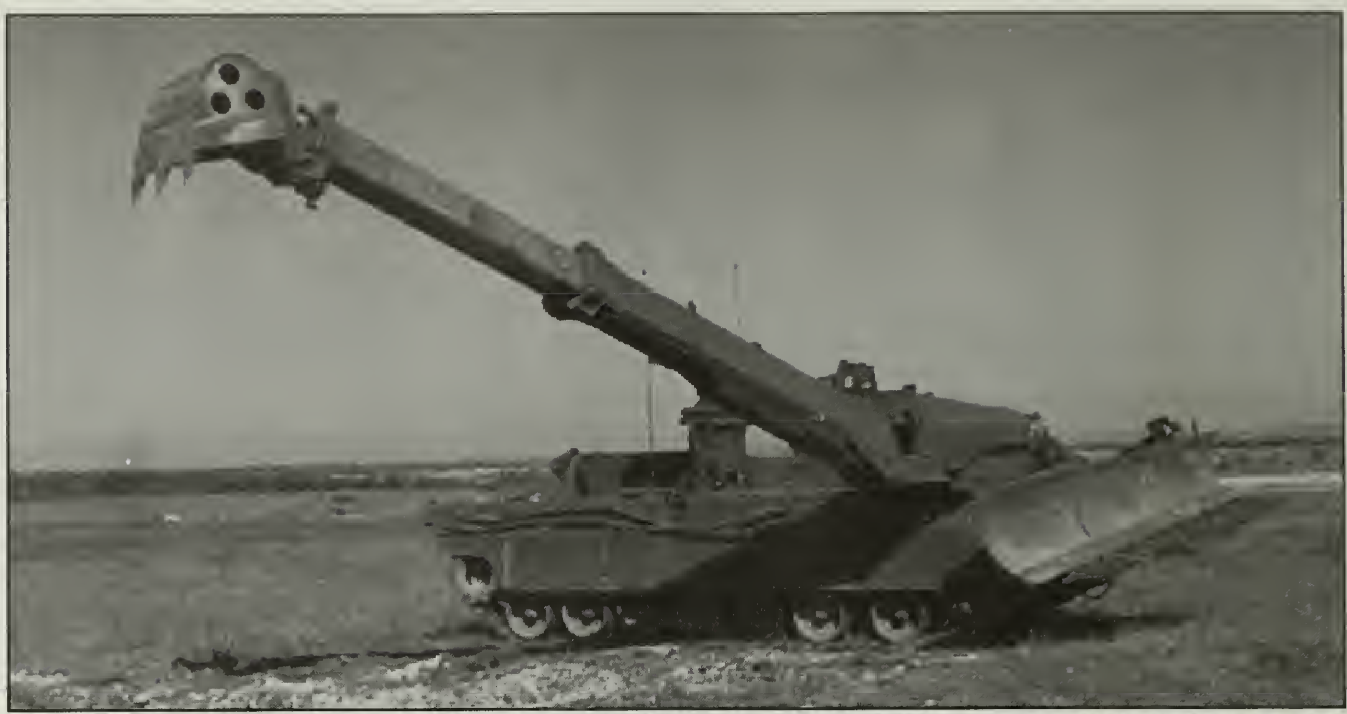


Figure 4. The power-driven arm on the Grizzly provides lifting, grappling, and dirt-moving capabilities to breaches. The arm and the blade work together to enable the crew to reduce tank ditches and log cribs and move rubble.

detonation of pressure-fused mines. The Grizzly blade is also effective against the full spectrum of the the mine threat. Perhaps most importantly, the Grizzly clears the full width of the lane, in contrast to the track-width clearance available today.

A power-driven arm (Figure 4) on the Grizzly is adapted from commercial construction equipment. It provides lifting, grappling, and dirt-moving capabilities to breaches. Working together, the arm and the blade enable the crew to reduce tank ditches and log cribs and move rubble.

The Grizzly is designed for under-armor operations, which require external cameras to permit day, night, and all-weather operations. In addition, the Grizzly will be fully integrated into the Force XXI digital information system using the Force XXI Battle Command, Brigade and Below (FBCB2) software. The Grizzly will be the first drive-by-wire (computer-controlled) vehicle in the Army inventory.

Program Status

United Defense Limited Partnership is under contract to mature existing prototype vehicles for government evaluation and testing before the low-rate initial production decision, which is scheduled for the spring of FY 2000. Testing will include operational tests with soldiers, technical testing, and live-fire tests (including mine-blast tests). A total buy of 366 vehicles is planned, with fielding to heavy division and corps (mechanized) engineer battalions scheduled to begin in FY 2004.

Prospects

The Force XXI Army promises to possess an information advantage over our adversaries. Effective mobility support is essential to exploit this advantage. The Grizzly provides a revolutionary capability to the force—the ability to defeat complex obstacles while maintaining the pace and momentum of the attack. The Grizzly is essential for our Army to meet the Force XXI objectives to dominate maneuver and win the information war.

Lieutenant Colonel Kotchman, an ordnance officer with more than 18 years of service, is product manager for the Grizzly program at the Detroit Arsenal, Warren, Michigan. He is a graduate of the U.S. Military Academy and holds a master's degree from Rensselaer Polytechnic Institute, Troy, New York.

Mr. Glasgow is a military equipment analyst and technical writer with Camber Corporation, in Warren, Michigan. A former U.S. Army officer, he trained as a research, development, and acquisition specialist with assignments as an operational tester at Fort Sill and materiel developer at the U.S. Army Tank-Automotive and Armaments Command, Warren, Michigan.

Lieutenant Colonel Greene is Division Chief, TRADOC Systems Manager, Engineer Combat Systems, U.S. Army Engineer School, Fort Leonard Wood, Missouri. He is an engineer officer in the Army Acquisition Corps and a registered professional engineer. LTC Greene holds a doctorate from the University of Southern California.

BE AWARE

MINES DON'T CARE

Promoting Effective Countermine Operations in Bosnia-Herzegovina

By Lieutenant Colonel Christopher J. Toomey and Major John Q. Killip

Mines continue to be a major threat to reconstruction in Bosnia-Herzegovina.

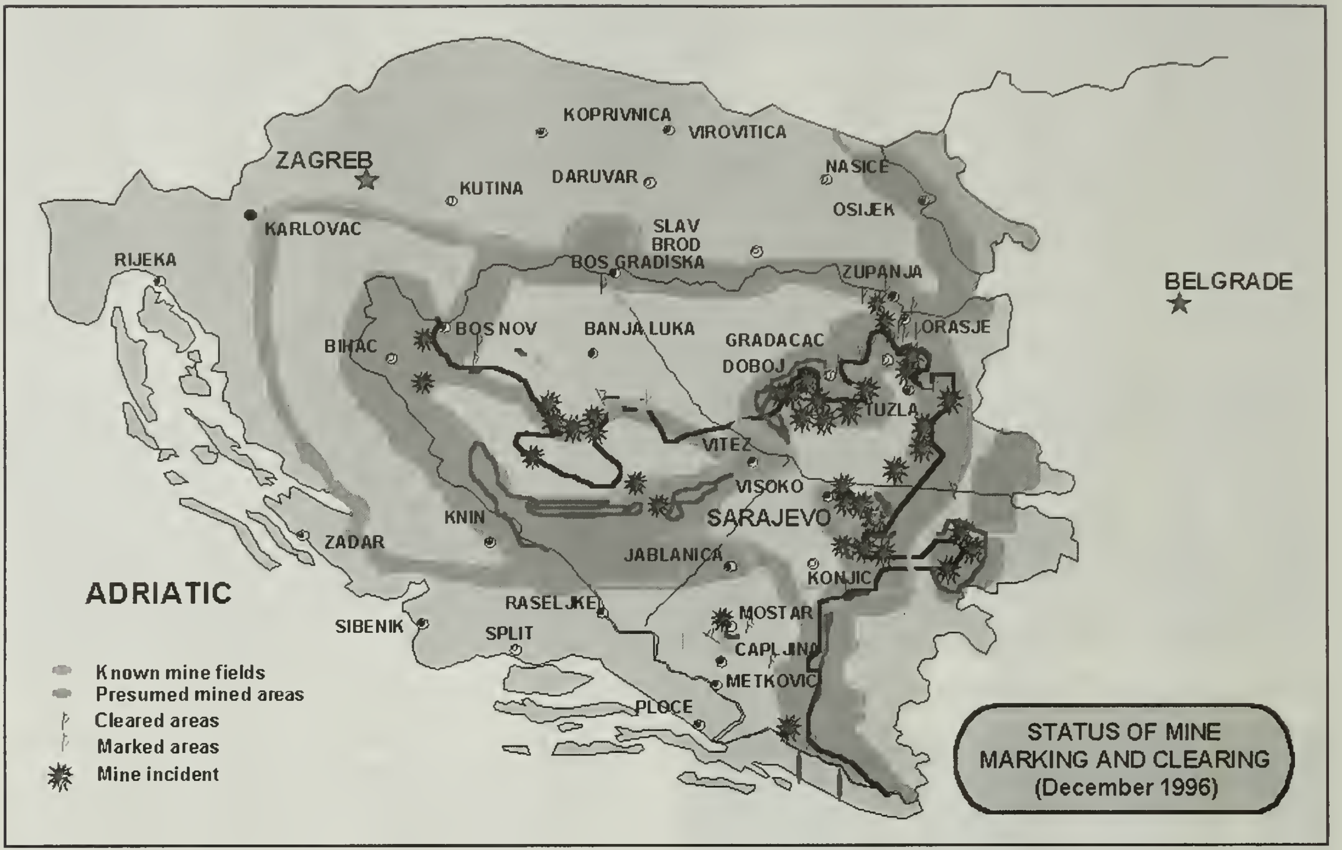
With an estimated 3 to 6 million mines and pieces of unexploded ordnance (UXO) left on the ground, the pervasive mine threat in Bosnia-Herzegovina continues to be a major obstacle to achieving lasting stability and furthering reconstruction efforts in the country. Mined areas include many roads, bridge sites, and industrial complexes, as well as nearly 22 percent of cultivable land. There are about 150 mines per square mile. Plans for every project to rebuild a bridge, grade a road, or repair a building must consider costly and time-consuming mine surveys and clearance operations.

Key to Stability

Within this environment, NATO's Stabilization Force (SFOR) has the mission to ensure peace and stability. From the start, the SFOR recognized that the mine threat had to be reduced to ensure the safety of the population and NATO forces and to encourage the international community's long-term support for reconstruction.

A fair amount of interest and investment exists in Bosnia for removing mines (referred to as *demining*). Among the organizations with a role in promoting countermine operations are the United Nations Mine Action Center (UNMAC), the SFOR (which works through the Chief, Combined Joint Engineer (CJENGR), Entity Armies (EA), governmental agencies, and nongovernmental agencies. Because the country lacks centralized direction and a national demining policy, the actions of these organizations often are uncoordinated and nonsupporting.

This article focuses on efforts of the SFOR CJENGR to develop and shape humanitarian demining programs in



STATUS OF MINE MARKING AND CLEARING (December 1996)

Bosnia. The intent of these programs is to systematically reduce the mine threat, promote stability, and foster economic regeneration. We will outline the development of a theater-wide strategy to promote effective demining within the framework of peace support operations.

Terminology

Far from being a trivial exercise in semantics, the myriad of terms used to discuss mine-removal operations in Bosnia requires clear understanding. One of the CJENGR's first jobs was to work with the various participants and establish consistent terminology. The United States distinguishes between countermine operations (military breaching and mine-clearance activities in support of a mission) and humanitarian demining (the removal of mines as an end in itself). This distinction is not universally accepted within the theater's international community. Some key terms used in theater follow:

- ***Mine lifting.*** The removal of specific mines, as shown on a minefield record. It is not the systematic inspection of each piece of ground; it is the removal of known mines from a record. This technique often leaves unrecorded mines and UXO on the ground.

- ***Mine clearing.*** The systematic checking of each portion of ground to a particular standard. Most organizations in theater use a mix of manual and mechanical techniques, including probing, to conduct clearing operations.

- ***Humanitarian demining.*** A clearing standard that removes 99.6 percent of existing mines. In practice, mine-clearance techniques are discussed in terms of the "ability to produce a humanitarian standard." Probing at $10\ cm^2$ intervals can theoretically produce this result. The standard originated with the UNMAC, which has used similar standards in other parts of the world.

The Demining Community

Several groups are involved in demining activities throughout Bosnia.

Stabilization Force

Across the theater, the SFOR (primarily combat engineers) removes mines using military techniques. Because mine removal is a risky operation, the SFOR developed a rather conservative policy that reflects their force-protection concerns. Demining by the SFOR takes place only when it—

- Supports freedom of movement or training the SFOR (e.g., it is in the interest of the force).
- Is approved by the nation executing the mission.
- Is approved by the SFOR commander.

Entity Armies

According to the Dayton Accords, the three EA (also known as the Former Warring Factions) are responsible for ensuring the timely marking and removal of mines and UXO in the country. Until spring 1997, this effort was lackluster for several reasons:

Humanitarian demining requires painstaking and careful probing.

- *Incomplete information.* A 1996 study by United Kingdom Royal Engineers operating in Bosnia's Multinational Division Southwest indicated there was a less than 60-percent correlation between minefield records and mines on the ground. Since mines were employed by all forces at all levels (from well-trained, corps-level engineers who produced detailed, highly accurate records to embattled infantry platoons with "back-of-the-envelope" diagrams), a wide disparity exists in the accuracy and clarity of reports. Many minefields never were recorded or marked.

- *Lack of training.* Due to post-hostility demobilization, the EA lost much demining expertise and mine-clearing equipment.

- *Lack of will.* Although never explicitly stated, a lack of willpower on the part of the EA to conduct mine-removal operations is evident—particularly in certain areas. It is clear that some mined areas are still considered viable for use in the event hostilities recommence. Thus, targeting specific areas for EA demining activities meets with resistance.

According to the Dayton Accords, the EA will record, mark, and lift minefields. These actions are monitored by the SFOR. Monitoring involves verifying that EA forces remove the density (number) of mines shown on minefield records or the number of mines the EA claim are in a minefield.

United Nations Mine Action Center

The United Nations has charged the UNMAC to coordinate the efforts of all civilian demining activities in Bosnia. Staffed by civilians with a wealth of demining experience, the UNMAC does not physically take out mines. Instead, the UNMAC performs the following functions:

- ***Maintain minefield information.*** The UNMAC maintains the minefield database, which lists all known and suspected mined locations.

- ***Certify demining companies and teams.*** A major task is to review the training documentation and techniques used by demining organizations and certify their competency. The UNMAC gives demining organizations a "seal of approval" but does not take responsibility for their demining actions.

- ***Synchronize demining activities.*** The UNMAC attempts to synchronize the activities of various demining organizations within the country to ensure that the "right" areas are addressed at the right time.

International and Nongovernmental Organizations

Numerous agencies and groups, including commercial deminers, are involved in mine-removal operations in the region. They profit from the extensive demining requirements associated with reconstruction. Normally led by experienced personnel from outside Bosnia, these organizations employ civilians and former soldiers of the EA. The UNMAC certifies the techniques used by private companies hired by both local governments and other agencies, such as the U.S. Agency for International Development (USAID). Some agencies, such as USAID, routinely budget the cost of hiring deminers in their projects.

In addition to the commercial demining companies, some U.N.-certified volunteer organizations come to Bosnia to contribute to the demining effort.

Obstacles to Success

Initially, the mine-removal community did not agree to accept a specific standard. The UNMAC focused on endorsing clearance to a humanitarian standard (99.6 percent). The EA originally conducted only mine-lifting operations because that was the extent of their capabilities. As far as the UNMAC was concerned, the EA did not conduct any recognizable humanitarian demining operations. Although the EA removed mines from minefield records, the UNMAC believed that mined areas must be cleared to a humanitarian standard in order to be considered "safe." In practice, the UNMAC position nullified the clearance activities of the EA and fostered a lack of confidence in mine lifting as a viable method for clearing well-recorded minefields.

Reliable data concerning the location, composition, and extent of minefields in Bosnia are lacking. Even though the EA are charged to turn over all minefield and UXO records, many of the minefields are either unrecorded or the records are not released. Many of the records turned over to the SFOR and the UNMAC are inaccurate and incomplete, and record management is a continuing problem. At the start of

1997, minefield records were kept at the Multinational Divisional level, the SFOR level, and with the UNMAC. In addition, several independent databases were kept by other organizations, such as the World Bank.

Early in 1997, uncoordinated efforts resulted in discrete mine-removal activity, but there was no systematic approach to clearing areas tied to reconstruction or the priorities of other lead organizations, such as the United Nations High Commission for Refugees and the Organizations for Security and Cooperation in Europe.

SFOR Campaign to Promote Effective Demining

Ultimate responsibility for formulating and continuing an effective humanitarian demining program is not an SFOR responsibility. The civilian leadership—both U.N. and national authorities—are ultimately responsible for the success of an effective countermine program. However, the climate in late 1996 and early 1997 was such that SFOR determined it *had* to take the lead in jump starting a country-wide demining program.

When developing a campaign plan, the CJENGR determined that a major goal of the campaign must be to promote effective demining activities. To accomplish this goal, the CJENGR established several initial objectives:

- Develop the EA humanitarian demining capabilities.
- Foster mine-awareness programs.
- Synchronize demining activities.
- Strengthen the position of the UNMAC as the leader in demining activities.
- Encourage greater participation by international organizations.

Developing Entity Army Capabilities

For various reasons, EA demining activity was at a virtual halt by December 1996. Not only were the EA not conducting viable mine-removal activities, they did not possess valid plans to begin mine-removal operations. Therefore, the CJENGR took several steps to re-energize the EA:

- ***Link mine-removal activity to movement and training.*** The commander of SFOR has authority to take actions necessary to ensure EA compliance with the military provisions of the Dayton Accords, including the requirement to conduct demining. A major step was to firmly link EA privileges—notably their ability to train and move their forces—to evidence of demining activities. This step provided excellent motivation for the EA to initiate demining activities.
- ***Make the policy concrete.*** The EA and subordinate multinational divisions were unclear as to what constituted successful demining activities. The CJENGR clarified demining policies and spelled out concrete objectives and requirements in the COMSFOR-endorsed *Instructions to Parties*. A companion document, not given to the EA, is Campaign Directive 21, *Countermine Operations*, which provides additional guidance on administering activities to monitor demining.
- ***Review EA plans.*** The EA were required to produce detailed plans outlining how and where their mine-removal assets would be used. The CJENGR took the ini-

The damaged Lipovac railroad bridge was demined by the Entity Armies in the summer of 1997 and repaired by USAID later that fall.

tiative to recommend adjustments to the plans to ensure an adequate pace and priority of demining. In addition, emphasis was placed on demining areas targeted for reconstruction.

- ***Support bilateral initiatives for equipment and training.*** Several bilateral initiatives emerged, notably one initiated by the U.S. Department of State's Demining Commission (USDC). The USDC sponsored countermine training for about 450 EA soldiers that focused on clearing mines to a humanitarian standard (vice mine lifting). The CJENGR recognized this training as a great opportunity and developed strict requirements for compliance.
- ***Promote certification through the UNMAC.*** One problem with EA mine-removal operations was the lack of recognition they received as credible deminers. With the enhanced training provided by USDC, the CJENGR and UNMAC worked to gain recognition for EA mine-clearing activities.

Fostering Mine Awareness

To foster mine awareness, the CJENGR supported the SFOR's information campaign to make the local population cognizant of the mine threat. The campaign focused on developing posters and making radio broadcasts to describe the mine threat.

The information campaign on mine awareness was also directed at the international community to encourage support for demining and reconstruction activities. A major initiative was to develop brochures outlining current successes and shortcomings. These brochures were distributed at a World Bank donors' conference and other meetings.

The CJENGR established a training team to enhance mine awareness among the SFOR and local organizations. The team consists of several highly trained mine experts, who are available to conduct briefings and training on mine awareness.

Synchronizing Efforts

The CJENGR chaired a series of meetings throughout the spring of 1997 with the UNMAC, the United Nations High Commission for Refugees, the World Bank, and other interested parties. Dialogue at these meetings tied demining activities to reconstruction efforts, proposed refugee-return programs, and supported pending municipal elections in various sectors. The goal was to ensure that demining occurred in high-payoff areas.

During these meetings, the role of the EA evolved within the total mine-clearance scheme. Although the UNMAC refused to recognize the EA capability as viable to achieving a humanitarian standard (even with the USDC-sponsored training), the UNMAC agreed to incorporate EA mine removal in their overall assessment of mined and cleared areas. Additionally, the UNMAC recognized that EA mine removal at any level was preferable to no action and supported using the EA to lift and clear high-density minefields.

Promoting the UNMAC

It is important for the UNMAC to be the recognized leader in the long-term mine-removal program in Bosnia for several reasons. First, the UNMAC is charged with this role by both the United Nations and the London Agreement of January 1997. The London Agreement specifies the UNMAC as the lead agency in orchestrating mine-removal operations throughout the country until the Bosnian Commission on Demining is established. Second, as a prime agent of the United Nations, the UNMAC must have the confidence of the international community. Also, because the SFOR's charter is limited, that agency should not be the demonstrative leader in the long-term, mine-removal program.

Promoting the UNMAC took two forms. First was the consolidation of mine databases. As late as December 1996, the SFOR and the UNMAC maintained separate databases of information on mined areas. Most of the information in the SFOR database came from the EA through subordinate units, while the UNMAC received its data through civilian agencies. After publicly proclaiming the UNMAC as the lead agency, the SFOR reformatted its database to ensure compatibility with the UNMAC's database and transferred all information to it. To ensure a smooth transition, the CJENGR established a liaison cell at the UNMAC to assist in data collection and transfer. By March 1997, the data transfer was complete and the UNMAC, assisted by the SFOR cell, was in the lead.

The second form of promoting the UNMAC was to create situations where that organization could demonstrate its leadership, such as at countermine working groups. Whenever possible, the CJENGR supported and promoted these meetings. While they did not always produce concrete results, the meetings served to maintain dialogue within the demining community.

Encouraging Support from International Organizations

The long-term success of mine-removal operations in Bosnia hinges on the commitment of the international community to resource the effort. Through loans for either humanitarian demining or as part of reconstruction projects, the eventual clearing of most land mines will happen only if the international community establishes an indigenous, sustainable program.

The CJENGR seeks ways to encourage support. One way is through direct contact with organizations working in Bosnia, such as the World Bank. For example, the CJENGR asked the World Bank to provide loans to support additional dog mine-survey teams to increase the tempo of clearance verification. A practical problem with this sort of funding is that it requires loans to the Bosnian government, making it necessary to convince Bosnian leaders to accept the loans. (This problem is also prevalent in many construction loans, but that's another article.)

Examples of the numerous mines and UXO that litter the Bosnian countryside.

Development of a viable information campaign that targets the international community is instrumental in garnering support. By working with the SFOR's information campaign, the CJENGR produced pamphlets and flyers to alert the international community of mine-removal successes and to solicit assistance.

A Success Story

The SFOR's efforts improved the overall mine situation in Bosnia. An example is EA demining at the Lipovac and Kalavac bridges along the Tuzla-Brcko Railway.

A major initiative in the region was to re-establish a viable commercial rail system. Among the sections of rail line targeted for reconstruction was the section between Tuzla and Brcko, which would link with rail systems in Croatia and Hungary. Funded by USAID, the construction involved local contractors and NATO troops. Two bridges along the line at Lipovac and Kalavac were critical. These bridges had been severely damaged during the war and were heavily mined. To reduce the cost to USAID, SFOR decided to pursue demining using EA soldiers trained by the USDC. Direct coordination with contractors executing the construction established that this plan was acceptable, and the area was demined.

This example illustrates the relative success of the SFOR CJENGR initiatives. With increased training and multiagency coordination, the EA conducted humanitarian mine clearance in direct support of civil reconstruction. The initiative could not have occurred several months earlier.

An Uncertain Future

Humanitarian demining in Bosnia-Herzegovina is not nearly as effective as it could be, despite the outstanding efforts of the SFOR and other agencies. Although the CJENGR's efforts were positive, mine-clearance operations will be ongoing for many years and will be successful only if the international community continues to provide funding. Mine clearance is very expensive, both in terms of training and contracting. Costs can be minimized by targeting areas that yield the greatest benefit for reconstruction. Nonetheless, it will take countless millions of dollars and years of effort through a sustained program to make mine clearance a success.

More importantly, government leaders in Bosnia-Herzegovina must actively support mine clearance. They must turn over minefield records, actively pursue mine removal by the EA, and prove to the international community that they are committed to removing the mines. In short, they must make the country safe for its own people.

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Major Killip, Royal Engineer, United Kingdom Army, served as the SFOR's Engineer Intelligence Officer. He is a 1986 graduate of the Royal Military Academy, Sandhurst.

30 Years Held in Reserve:

Nothing's Easy, but the Team Can Do It!

This article could be a historical review, but I want it to be a glimpse toward the future. My experiences of the past 30 years are used to examine how we might consider moving into the 21st century. In particular, I will focus on the need for team-building communication that informs, seeks continuous feedback to improve team accomplishments, and trains the force.

Inform

We were moving through the pine-forested mountains of northeastern New Mexico in early August 1967. I was beginning my enlisted service with a military unit—this was my first drill. Uniforms and equipment would not be issued to me until I started basic training at Fort Bliss, Texas, in September. I remember feeling like the odd man out, because I was not in uniform. No one had informed me that we were going to the field, so I was dressed in casual clothes and wore slip-on loafers. We were in the mountains to complete a compass-orienteering course set up by the unit's noncommissioned officers. My teammate and I, along with the other teams, successfully completed the course.

Overall the day had gone well, even though I had slipped and slid over the rough terrain, but the day was not over. Riding down the Rocky Mountains in the back of an uncovered 2 1/2-ton truck, we rode most of the way back to the armory unprotected in a midsummer downpour of cold rain. The other soldiers had ponchos, but the new private did not. No one offered to assist me. My impression was that teamwork was reserved for military operations, not for personal problems or new recruits.

Now, 30 years later, I can recall this incident with a little humor. But let's look into the future. How many of today's service members consider themselves to be uninformed members of a military team or only part-time team members? How many service members find themselves without the information and communications they need to remain true "team members" in times of personal crisis? I am speaking of job-related as well as personal crises. Some units find it easier to replace an individual than to determine a team solution that will move a team member and the team beyond a crisis.

We don't know what crises may face those who will serve our country in the years ahead, but one we can foresee is that of unnecessary stress. Most people agree that some stress is beneficial, because it can build character. Unnecessary stress, however, such as that resulting from a failure to communicate effectively, harms the very team cohesiveness we seek to build. Informing, seeking continuous feedback, and training go a long way toward reducing the magnitude of a crisis.

Let's return to the introductory vignette, where I am dressed inappropriately in a field setting and in a summer rainstorm, and look for lessons that will apply to future teams. My circumstances could have been alleviated easily if the weekend's planned events had been passed to me. With proper information, responsibility of how to dress would have been mine. The team could not be faulted had I been informed. So one major way to relieve undue stress is simply to ensure that everyone on the team gets the word.

Seek Feedback

In these high-tech days of phones, faxes, e-mail, Internet, intranets, video teleconferencing, etc., there are many ways to get the word out. What is equally crucial, though, is obtaining feedback to check the clarity

By Lieutenant Colonel Richard Reid

of the message sent. The future of military operations looks bright with regard to our ability to broadcast messages. I feel our leadership needs to focus on ensuring that every message (be it information or formal training) has an interactive piece. In my case, a short phone call from an assigned enlisted sponsor would have alerted me of the weekend events in the mountains and provided an opportunity for me to query my sponsor. Information is power, and power builds teams. Two-way (interactive) communication is key.

Interactive information helps alleviate inordinate stress. The military is not a "democratic" organization, nor can it be, but in most circumstances feedback from team members is extremely useful and should be sought. The phrase "I just can't get anyone to listen" is never the norm in a vibrant military organization, today or in the future.

As we move into the 21st century and commend ourselves on the successes of the past 100 years, we should remember that interactive communication has been a critical piece in achieving military successes. Our failure to achieve overall victory in Vietnam is attributable, in part, to weak interactive communication, which hindered operations at the highest strategic levels and extended throughout the services and commands to field-level combat teams. Although this century is apparently ending in relative peace, soldiers still face the possibility of a cold, wet ride down a mountain. How does your team prepare for potential eventualities and stressful military operations that may suddenly appear?

Train

One way military units keep team members informed is through training that occurs at all levels. Future training may be provided on an as-needed, per-request basis to an individual, a team, or a unit. Training courses will be available for students on-site when necessary, but a large portion will be conducted in distance-learning formats via the Internet, intranets, satellite links, virtual reality, and CDs, as these media become available.

Distance learning and computer-generated training are not training modes of the future—they are used in industry, academia, and the military today. Simulations, including virtual reality and enhanced virtual reality, soon will be more widely available to military trainers and will provide authentic training experiences for students. Pros and cons can be made for how simulations impact interpersonal communications. The capability for communication transmission is growing exponentially, but management of communication traffic will remain a challenge for individuals and organizations for the foreseeable future.

Realistically, some equipment training must advance beyond the use of simulators and simulations, and some training will continue to be performed on-site. Hands-on training for specific equipment ultimately will require that soldiers be on-site with the equipment. Much of the stress and expense associated with relocating, even temporarily, for training soldiers can be eliminated if most of it is accomplished close to home. This will be possible when both Active and Reserve Component soldiers can access real-time training at their convenience or participate in training activities on their personal time by using the Internet and other distance-learning modes.

Another way to reduce undue stress is to ensure that effective training is prepared, produced, and provided by professionals who understand the medium used to present the material and who select the proper method of delivering it. The Army and the Engineer School are working hard at developing the staff to better use new training technologies as they become available at reasonable cost.

A Final Look at Feedback

Communication is key. A common complaint I hear when attending active duty training as a Reserve officer, is the expressed and implied grievance that workers can't get those above them to listen to their ideas and observations. "Worker bees" often feel left out of the feedback and improvement loop. Some of this cannot be helped, but I have observed that communication between supervisors and workers often needs improvement. It is easy to slide into the trap of telling supervisors only what they want to hear, and some supervisors imply they only want to hear "good" news. Obviously, any management technique that fails to communicate fully produces great stress for all concerned. Such techniques hinder mission accomplishment and do not help the organization grow and prosper.

There are many ways to disseminate training, and we should use them to engage in effective dialogue regarding matters affecting training. For example, each revision to Army training affects many individuals and organizations. We must use all of the communication tools at our disposal to make training more effective and to sharpen our communication skills.

Information is power. To prevent future "cold rides down the mountainside," we must provide information to everyone who needs it. Two-way, interactive communication will help reduce unnecessary stress on all members of our team. Because we fight like we train, we must employ up-to-date training and training methods.

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"Colonel, You're Fired!"

By Richard Chaney

Maps have always been paramount during military operations. Wise planning includes a mechanism for timely map production and dissemination, but even the best-planned operations may meet with disaster. An example of this occurred during World War II when unexpected problems caused map shortages that threatened the success of the European invasion. Although today's military has committed to the digital mapping environment, the technology creates new hazards as well as solutions. We must carefully consider both logistic and production factors.

The words in the title of this article were directed at Lieutenant Colonel Daniel Kennedy during the Battle of the Bulge in World War II. As chief of the Army Topographic Section of the 652d Engineer Topographic Battalion under Lieutenant General George S. Patton's Third Army, Kennedy was doing his best to improvise and make up for map shortages and rapidly changing battle plans.

Kennedy's reprimand came from Major General John S. Wood, commander of the 4th Armored Division, XII Corps, Third Army. At about the same time, Patton ordered General Wood to spearhead the attack into Alsace-Lorraine. Wood and his troops were exhausted from earlier battles and Wood replied, "Dammit George, we're not robots. We need a rest." Many officers and historians believe that Patton "fired" Wood at this point[1]. At about the same time, Wood sent a letter to the XII Corps commander concerning "the rotten map situation."[2] He "fired" Kennedy soon after.

Although General Wood reprimanded Kennedy more than 50 years ago, Kennedy still vividly recalls the sting. The words were a bitter reminder of the frustrating events that plagued battlefield engineer units during that

LTG Patton and MG Van Fleet examine a map layout of the Danube River area.

historic but trying period. Today, Kennedy's experience may serve as a "heads-up" for future engagements.

World War II

Much of the planning for the European invasion of World War II began in 1943. The General Staff estimated that the four U.S. Armies involved would need approximately 7 million maps each month. Since this was more than the base and field topographic units and local civilian facilities could provide, additional British and American facilities located in England were tasked for support. This wise planning was overshadowed by the disruptive events that followed.

During World War II, and particularly in the European Theater, most battles were characterized by rapid advancement over new and difficult terrain. "Go where you can, as fast as you can" was Patton's buzz phrase during his campaigns in France, and General Wood echoed this philosophy in his actions. However, when troops began their rapid advances, they were plagued by map shortages.

Map Shortages

Two major factors led to map shortages during the Battle of the Bulge. The first was directly related to enemy action, which impacted the situation early in the invasion; the second was logistical problems, which compounded most of the later shortages. Changes in distribution demands and weather conditions also took a heavy toll on early supply and logistics efforts.

Enemy Action. According to LTC Kennedy, most of the advance maps were aboard transport ships that sunk in Cherbourg harbor during the first days of the invasion. Many ships were sunk as they crossed the English Channel, while others were destroyed as they approached or entered French harbors. The few strategically located harbors (most notably, Cherbourg) were either heavily mined or too damaged to allow adequate discharge of ship cargoes.[3]

Logistical Problems. Subsequent to direct enemy action, most of the research indicates that logistics (specifically, distribution) was one of the biggest problems and bottlenecks to the mapping equation. Once inside the harbors, no one knew which ships to unload first. Although well-defined priorities were established, depending on the cargo type, strict adherence to these priorities meant time-consuming investigations of each load, followed by unloading only specific, partial cargoes. Meanwhile, other vessels and cargoes sat idle, creating additional congestion. The staff finally agreed to discharge each ship as quickly as possible regardless of cargo and then sort the supplies once they were ashore. This method greatly reduced harbor congestion, but it created confusion at several depots. During the unloading of Project Overlord, one frustrated staff officer jokingly summed up the entire harbor logistics problem: "The general principle is that the number of divisions required to capture the number of ports required to maintain those divisions is always greater than the number of divisions those ports can maintain." [4]

Distribution Demands. Although combat actions and congested harbors set the stage for many map shortages, additional problems compounded the situation. Topographic battalions were well-equipped and well-organized, but they were not adequately prepared to handle unexpected changes in demands. According to some experts, "The transportation [of map stocks] between depots and from depots to troops was to cause more trouble than any other aspect of map distribution on the continent." [5]

In some instances, maps were of no value because troop locations did not match the map coverage. However, this was not necessarily due to improper delivery of the maps. During the invasion of Utah Beach, the combination of naval artillery bombardment and Army Air Force bombs created so much dust and smoke that terrain features could not be seen. Radar could not distinguish between the different beaches, and strong tidal streams pulled about 20 of the first-wave landing craft completely off course. Although they met little enemy resistance and there was little surf to contend with, the troops soon realized that none of the local features matched their maps. Later Brigadier General Theodore Roosevelt Jr. discovered the problem. Having studied the terrain maps earlier, he realized that the troops had "slipped" about 2,000 yards south of the designated point.[6]

Weather. Record-breaking storms between 19 and 22 June 1944 caused heavy losses to supplies and equipment. According to the commander of assault force O, 90 ferrying craft and an undetermined number of larger craft were lost on Omaha Beach alone. The British estimate that they lost 250 ferrying craft, and about 800 additional craft were stranded on U.S. and British beaches. On 22 June, one eyewitness on Omaha Beach counted 335 LCMs (landing craft, mechanical), 11 LCTs (landing craft, tanks), 3 LCIs (landing craft, infantry), 9 rhino ferries, and more than 20 other craft piled up.[7]

Changes in Tactics

The demand for accurate maps on short notice has always been a high priority that requires constant reorganization and logical thinking to contend with changing cir-cumstances. In France, map shortages due to enemy action, logistics, distribution, and weather were exacerbated by changing tactics, particularly those of Patton's rapidly advancing forces. Patton's attack plans changed so often that there was insufficient time to make new maps to support the latest strategy. Kennedy remembers an all-too-familiar scene: "Each morning at 0900, Patton held a general's meeting and determined where each unit was going. Then he would leave to check the front lines. By 1900, he would have another meeting, and all the earlier decisions would change. We had to pitch the first maps and start on the new ones. This went on throughout most of the campaign."[8]

Because Patton demanded such quick map-support response, the Army Survey Center was cannibalized into a topographic section to better meet his needs. A photogrammetric camera and printing press capabilities were added to make it self-contained and capable of providing quick response. LTC Kennedy recalls many instances where the topographic section received carte blanche status to commandeer whatever supplies and facilities it needed.

The demand for maps exceeded all expectations, and a paper shortage became a major engineer supply problem. Local supplies of French paper stock were inadequate, so U.S. Army engineers printed about 10 million maps on the reverse side of captured German maps.[9] In areas such as the upper Rhone valley, small-scale maps were particularly scarce, and French units relied on Michelin road maps supplemented by information from local residents.[10]

Today's Army

Today's Army is committed to pursue digital technology and to provide cartographic products as they are needed. According to current map doctrine and AR 115-11, *Army Topography,* the U.S. Army Corps of Engineers remains the proponent for topography. Engineer topographic battalions are responsible for the production of special maps and terrain-related products and services. They also retain the ability to produce limited quantities of standard maps in the field.

Present and future technology allows us to use huge, global databases in many useful ways, but managing that information requires comparable levels of administration. System administrators must monitor and provide quick access to a wide spectrum of data through a more controlled intranet versus Internet environment. Simultaneously, organizations such as the National Imagery and Mapping Agency need access to deposit traditional or specialized cartographic products. Data managers must control both input and access to digital data from all sources, civilian and military. Additionally, many scenarios may require specific physical locations and levels of control, although physical location is less critical than it was during World War II.

The transfer medium poses another dichotomy. Many technological advances have geometrically increased the data storage capacity on either magnetic- or laser-imprinted materials. But these advances come with a price in survivability. One frequently asked question is: "Which would you rather have, a CD-ROM with a bullet hole or a paper map with a bullet hole?" Although a high-tech, "shoot-and-scoot" Army may reduce the possibility of receiving bullet holes, CDs are also more susceptible to damage from dust and moisture.

Learning From the Past

History reminds us that we should not place too much faith in technology. "Look what happened with the fratricide during Desert Storm," LTC Kennedy explains. "Technology is fine in controlled situations, but combat is usually unpredictable and far from controlled...[In combat situations] you have to be able to do anything. You have to adapt to situation requirements. There are basic things every engineer should know, but they need a broad range of knowledge to better prepare them for a wide set of circumstances. Then they must use common sense and make do with what they have."

After we survived the problems during the Battle of the Bulge, historians placed a "mark on the wall." It was a strong reminder that we need to possess and be able to disseminate critical terrain information on demand. When a general requests maps from an engineer, the engineer must produce them. To accomplish this, he must have appropriate equipment and supplies and be able to disseminate the finished products.

Could a similar mapping problem occur today? In this age of advanced digital imaging, can we still lose maps on a sinking ship? Many experts believe a similar scenario is possible. The logistics of transfer medium, data management, training, and support are elements that we must scrutinize from every angle. If we fail to learn from the past, we may find ourselves in a situation similar to LTC Kennedy's. We cannot afford to be lulled into technological complacency or to produce critical information only to let it "sink in Cherbourg Harbor." If that happens, the next outcry we hear may be more tragic than "Colonel, you're fired!"

Mr. Chaney is a physical scientist at the U.S Army Engineer School and a terrain analyst warrant officer with the Missouri National Guard. He previously worked as a cartographer for the U.S.Geological Survey, National Mapping Division, Rolla, Missouri, and was editor of the division's publication Topographically Speaking. *Mr. Chaney holds a master's degree in geography from Oregon State University.*

Endnotes:

[1] Nat Frenkel and Larry Smith, *Patton's Best: An Informal History of the 4th Armored Division*, Hawthorn Books, Inc., New York, 1989.

[2] John Wood, Commander, 4th Armored Division. Letter to Commander, XII Corps, referencing the "rotten map situation."

[3] *Samuel E.* Morison, *The Invasion of France and Germany, 1944-1945. History of United States Naval Operations in World War II, Vol. II.* Atlantic Monthly Press, Little Brown and Company, Boston, 1957, p. 304.

[4] Roland G. Rupenthal. *Logistical Support of the Armies*, Vol. II, 1958, p. 46.

[5] Alfred M. Beck, et al. *United States Army in World War II. The Technical Services. The Corps of Engineers: The War Against Germany*, Center of Military History, Washington, D.C., 1985, p. 297.

[6] Rupenthal, p.100.

[7] Gordon A. Harrison, *Cross-Channel Attack*, 1997, pp. 423, 426.

[8] Interview with Daniel Kennedy, Rolla, Missouri, 3 October 1996.

[9] Rupenthal, p. 216.

[10] Beck, p. 454.

(Continued on page 20)

THE MARTEN:

A QUANTUM LEAP FOR ENGINEERS

By Alan Schlie

Let me introduce you to a skid steer called the MARTEN. We have the Grizzly and Wolverine, which are system names, and we have the ACE and the DEUCE, which are acronyms. So I present to you the MARTEN—manpower augmentation, robotics-capable tractor for engineers.

The marten (the animal) is a small, aggressive, agile, and quick carnivore of the weasel family. Its sharp claws are excellent for burrowing, climbing, attacking, and defending. The MARTEN (the skid steer) is a small, agile tool platform with the capability to significantly reduce man-hour requirements for obstacle emplacement and reduction, protective structures construction, and line-of-communications improvements.

Performance

In recently completed evaluations at Fort Knox, Kentucky, the MARTEN enabled combat engineer squads from the 19th Engineer Battalion to construct double-apron fence and triple-standard concertina wire fence 40 percent faster than the Army Training and Evaluation Program (ARTEP) standard (see table). The MARTEN excavated fighting positions and trenches in one-fourth the time allowed in the ARTEP standard (done by hand) and faster than excavating with a small emplacement excavator (SEE). The MARTEN and a squad of combat engineers completed log crib and log post obstacles so quickly that the ARTEP standard can be changed

Task Completion Times (Man-Hours)

Task	ARTEP Standard	MARTEN
Construct log crib	144	19.6
Construct log post	16	10.8
Construct triple-standard concertina fence	8	5.2
Construct double-apron fence	24	16.3
Construct two-soldier position	6	1.5
Construct machine-gun position	7	2.2
Construct fighting trench	12	10.5
Clear landing zone	24	16.2
Construct road crater	16	8.8
Install culvert	16	9.5

A soldier uses the MARTEN with its dirt bucket attachment to finish an antitank ditch.

from a platoon- to a squad-level task.

In a wooded area, the MARTEN helped a squad clear a landing zone in one-half the time allowed in the ARTEP. The MARTEN reduced by one-third the time needed to construct protective earth walls and substantially reduced the time required to excavate a trench for culvert emplacement and create boreholes for road-cratering charges.

The news isn't all good though. Two MARTENs would take 100 times as long as two bulldozers to construct a 300-meter tank ditch and twice as long as the dozers to reduce the same ditch.

The MARTEN represents the first conscious effort to augment the manpower of the combat engineer squad across the wide spectrum of field engineering tasks. With its 12 attachments, the MARTEN can bulldoze, bucket load, fork lift, compact, level, auger holes, backhoe, mix cement, sweep, fill sand bags, break concrete, drive pickets, carry logs, pull posts, pound nails, saw wood and metal, and flail mines. In other words, the MARTEN performs the repetitious and physically demanding activities associated with the combat engineering effort to shape the battlefield.

Think of the MARTEN as a first-generation exoskeleton for combat engineers. During the evaluation, 12Bs operated the skid steer and its attachments after only one week of training and stick time. It enables a single soldier to pick up, move, and accurately position objects weighing more than three-fourths of a ton, which is equivalent to two Bailey bridge panels and a transom. And operating in most terrain is not a problem with the MARTEN. It was evaluated in loose sand, deep mud, standing water, close woods, and uneven terrain.

The MARTEN is capable of increasing a combat engineer squad's productivity by 25 percent, which means that eight soldiers can do the work of ten. As the squad wears down physically, the MARTEN allows productivity to remain high. In some cases, with polished battle drills, the MARTEN enables a squad to complete platoon tasks, which enhances productivity and effectiveness.

The MARTEN is usable worldwide, in every deployment scenario imaginable. It is the perfect piece of equipment for engineers involved in natural disaster recovery and environmental cleanup, fighting forest fires, humanitarian relief, border security, base-camp construction, and unit bed down, as well as other battlefield uses.

Robotics Capable

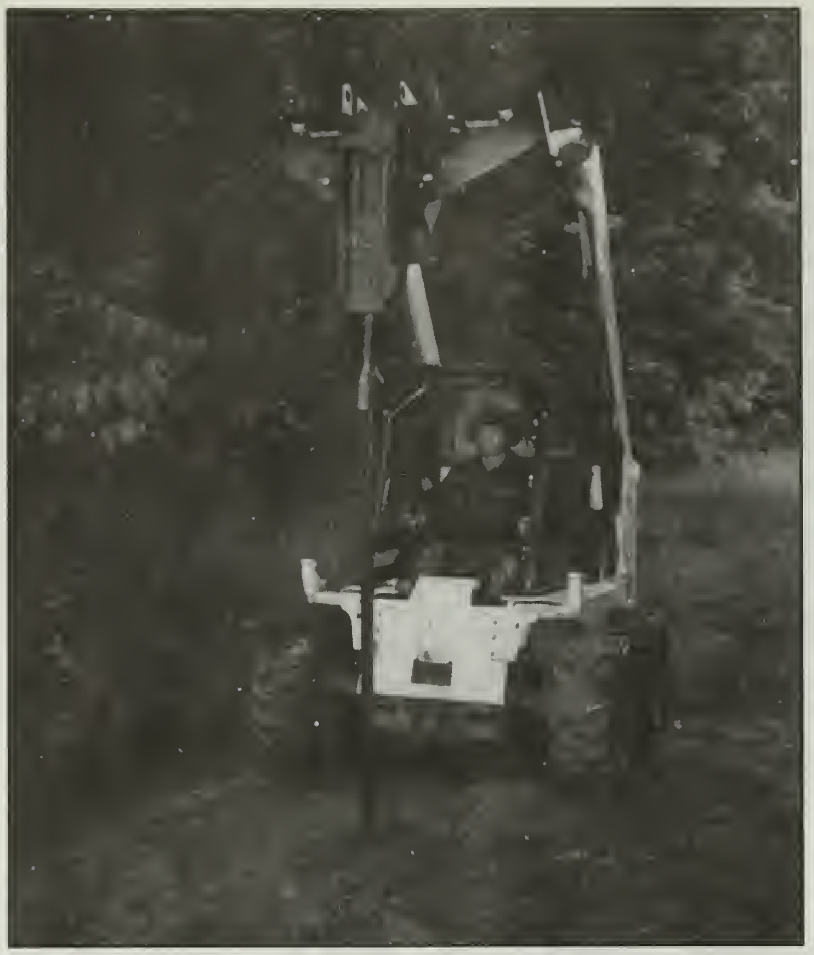
The MARTEN is capable of being fitted with robotics controls operable through the standardized teleoperating system (STS) currently in use. Wiring for the STS remains in place without hindering soldier-in-the-seat operation. The robotics capability allows continued use of all attachments and significantly increases the combat engineer squad's countermine operational capabilities. Skid steers already carry the miniflail and have been credited with saving lives in Bosnia.

Evaluation

The next step is a "right-size" evaluation being conducted at Fort Polk to determine which size skid steer performs best in various scenarios. The current limiting factor is obtaining a properly sized trailer for both the load and towing capacity of the prime mover.

As a system, the skid steer does not require further testing or evaluation. Its versatility and utility have been proven in commercial construction, utility, and landscaping industries. Our sister services already use skid steers within their organizations. The Engineer School will continue to review military applications, such as attachments to assist in bridge construction and McPherson-style plow blades.

Thirty-five platoon training and evaluation outlines (T&EOs) listed in ARTEP 5-145-11-MTP involve field engineering, obstacle construction or reduction, or construction of protective structures. Nine of these were evaluated during the skid steer concept evaluation at Fort Knox. Except for two of the T&EOs—tank ditch construction and reducing—the MARTEN performed better than the current methods.



This MARTEN is being used to drive U-shaped pickets for a double-apron fence.

Considering the results of the concept evaluation, we anticipate that an additional 20 tasks can be completed faster and more efficiently by using the skid steer instead of the current methods.

Shaping the Battlefield

Engineer organizations have heavy-duty, bladed equipment capable of moving substantial amounts of material to create tank ditches, berms, and fighting positions. Engineers also have access to mine-dispensing systems capable of creating large minefields in short periods of time. But squads are ill-equipped to handle the physically demanding and repetitive activities that constitute the major portion of the combat engineer's contribution to shaping the battlefield.

The MARTEN represents that missing system. It can work in restricted terrain while presenting the smallest practical target to quickly accomplish soldier-sized excavations, conduct assault and countermine operations without putting the soldier at risk, and help the shrinking combat engineer squad complete manpower-intensive tasks. The MARTEN completes the suite of equipment required to make engineers true architects of the battlefield.

Mr. Schlie is a Force Development Analyst with the Directorate of Combat Developments, U.S. Army Engineer School. A retired command sergeant major, he has served in various capacities in Europe, Korea, and CONUS throughout his career.

(Continued from page 17)

References:

Anderson, Duncan. *D-Day: The Story of the Longest Day*, Smithmark Books, New York, 1993.

Army Regulation 115-11, *Army Topography*, 30 November 1993.

Blumenson, Martin. *United States Army in World War II. The European Theater of Operations. Breakout and Pursuit*, Office of the Chief of Military History, Department of the Army, 1961.

A Brief History of Operations in Europe, 652d Engineer. (Top) Battalion (Det.), Third Army.

Cole, H.M. *United States Army in World War II. European Theater Operations. The Lorraine Campaign*, Office of the Chief of Military History, Department of the Army, 1950.

Essame, H. Patton. *A Study in Command*, Charles Scribner's Sons, New York, 1974.

Forty, George. *Patton's Third Army at War*, Arms and Armour Press, London, 1976.

Rupenthal, Roland G. *Logistical Support of the Armies, Volumes I and II. U.S. Army in World War II. European Theater Operations*, Office of the Chief of Military History, Department of the Army, 1953.

Utah Beach to Cherbourg (6 June-27 June 1944). American Forces in Action Series. Historical Division, Department of the Army Center of Military History, U.S. Army, Washington, 1947.

Whiting, Charles. *Patton*, Ballantine Books, Inc., New York, 1970.

Wright, Marshal S., ed. 652d Engineer Topographic Battalion. *We Followed Patton*. A Battalion Book.

Letter to the Editor

Engineer Reconnaissance Platoon: Overcoming the Lack of Engineer Recon Assets

I am writing in regard to an article by Michael W. Sayer in the August 1997 issue of *Engineer.* I currently serve as the British Exchange Officer, Royal Engineers, with the Engineer Brigade, 3rd Infantry Division (Mechanized) (3rd ID). My duty post is that of deputy engineer coordinator, until recently known as the assistant division engineer, a post I have filled for the past two years.

Mr. Sayer's article caught my attention, because what he proposes for the establishment of an engineer reconnaissance platoon within heavy engineer battalions mirrors almost identically the existing engineer reconnaissance troop (platoon) of a British Army close support engineer regiment (battalion), i.e., one that supports a manoeuvre brigade. I understand that plagiarism is just another form of flattery!

One area that Mr. Sayer's article and proposal do not address, however, is the provision of similar engineer expertise and capability to the heavy division's primary means of division-level ground reconnaissance—the division cavalry squadron. With all engineer battalions of the engineer brigade neatly aligned to manoeuvre brigades, providing engineer support to the division cavalry squadron is not a new problem or one that is easily solved. The need for a permanent engineer reconnaissance capability, however, could easily be included with the case put forward by Mr. Sayer.

During the 3rd ID's recent deployment to Egypt for Exercise Bright Star 97/98, we had the opportunity to work with the divisional reconnaissance battalion of the 3rd (UK) Division, the Household Cavalry Regiment. A British divisional reconnaissance battalion does not have the combat power of a U.S. division cavalry squadron, but its reconnaissance mission is very similar. To enable it to fulfill this mission, it is assigned an engineer reconnaissance platoon with sufficient squads to support the reconnaissance companies. As Mr. Sayer points out, engineer teams/squads will be very thinly spread across the battlefield. But with engineer capability available with both the division forward deployed reconnaissance (division cavalry) and with scout platoons within manoeuvre brigades, the opportunity exists to better direct and employ scarce assets.

By way of a simple example: The division is advancing with two brigades up with the division cavalry leading in a reconnaissance role. Intelligence preparation of the battlefield (IPB)/terrain analysis has identified a river line that crosses the division sector. The division cavalry is tasked to identify brigade avenues of advance forward. The information that is sent back, with engineer confirmation, is that the river will require AVLB bridging in the eastern sector between grids X-Y, while pontoon bridging will be needed in the western sector between grids A-B, hopefully confirming the IPB. This information allows engineer commanders and staff to prepare appropriate units. Perhaps more importantly, the information acts as a cue for limited brigade engineer reconnaissance teams, in conjunction with task force scouts, to target likely crossing sites. Other examples where engineer reconnaissance would be a bonus when integrated with the division cavalry are not hard to imagine.

Where this fourth engineer reconnaissance platoon should be established I am probably not best qualified to say. Perhaps it could be a permanent part of the division cavalry squadron's modified table of organization and equipment, with the very real difficulties of developing and monitoring appropriate training. Another option is to establish the platoon as part of the headquarters and headquarters detachment, engineer brigade—although this probably is not a long-term starter in view of current proposals to remove the engineer brigade headquarters from heavy divisions.

In summary, I think that the debate started by Mr. Sayer's article should be broadened to include an engineer reconnaissance capability for the division cavalry squadron.

Major Allan P. Dennis
Royal Engineers

Author's reply:

Thank you for contributing to my discussion. Although America and Great Britain are, to quote Will Rogers, "two countries separated by a common language," great ideas arise from both sides of the "pond." So I'll plead not guilty to plagiarism but hope the debate helps our Engineer Regiment.

When writing my article, I purposely limited discussion to the heavy brigades, because I have not seen the reconnaissance weakness inherent within the heavy brigades replicated in the division cavalry squadrons. Although dedicated support units do not routinely train with the squadron, the division engineer provides one engineer company (I hope one of the best) to the squadron for engineer support. A military occupational specialty (MOS)19D Scout NCO is required to perform most of the same reconnaissance tasks as those performed by an MOS 12B Scout NCO. Therefore, it would be difficult to support the manpower requirements for a reconnaissance element with a division cavalry support mission. In a perfect world, with sufficient manpower and money available, I have some definite ideas as to what would provide great support. Unfortunately, given current manpower constraints, none of those ideas are feasible.

Michael Sayer
Military analyst

Command and Control:

Seeing the Battlefield

By Colonel Thomas Bostick and Captain Matthew Pasvogel

Many maneuver commanders throughout history have made key decisions regarding commitment of important resources with very little information or time. During the Battle of Gettysburg, for instance, lack of information from J.E.B. Stuart's cavalry had a significant impact on Robert E. Lee's decisions. Unknown to Lee, Stuart was involved in an independent operation, which denied Lee the "eyes" necessary to gather information about the Union Army. This lack of timely information contributed to the Army of Northern Virginia's defeat in a battle that became the turning point of the Civil War.

At times the "fog" of war makes disseminating information difficult. In many instances, however, standard operating procedures for communicating information leads units down a path of potential problems. Staffs can simplify the complex battlefield decision-making process to help commanders mass combat power. By preparing an effective matrix or sketch, staffs can help commanders "see" important elements of the battlefield, including friendly and enemy capabilities, terrain, and key decision points.

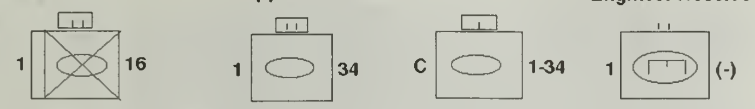
This article describes simple techniques used in offensive and defensive operations that facilitate the decision-making process and allow commanders to better "see the battlefield." The 1st Brigade Combat Team (BCT) and the 1st Engineer Battalion of the 1st Infantry Division from Fort Riley, Kansas, successfully validated these techniques at the National Training Center (NTC).

Offensive Operations

During offensive operations, friendly forces often face formidable enemy obstacles. Commanders must understand the assets needed to reduce or bypass these obstacles. Equally important, commanders must know the decision points where they can reallocate mobility assets within the combined arms team. To achieve this understanding, planners must identify the minimum critical resources at the breach site (M-CRABS).

Based on the engineer estimate, planners allocate critical reduction assets. These include engineer platoons, mobility reserve, armored combat earthmovers (ACEs), mine-clearing line charges (MICLICs), and tank plows to either bypass an obstacle or reduce, mark, and proof a lane. Reduction assets are task organized to subordinate units using appropriate planning factors (see Figure 1, page 23). Those factors include:

- A 50- percent loss of reduction assets while reducing, marking, and proofing a lane.
- A 60- to 90-meter enemy minefield depth, which friendly forces can reduce, at some risk, by using two MICLICs.
- An engineer platoon to mark a bypass around scatterable minefields or two tank plows to reduce them if necessary.



Assets required to complete each phase and follow-on phases

Main Effort	Support Effort	Reserve	Engineer Reserve	Current Phase
2 MICLICs 4 Plows 2 ACEs 2 Platoons	0 MICLICs 2 Plows 3 ACEs 1 Platoon	1 Volcano	3 MICLICs 2 ACEs 1 Platoon	LD: Total starting assets (on hand)
2 MICLICs S ● 2 Plows 2 ACEs 2 Platoons (mark bypass)	0 MICLICs 2 Plows 2 ACEs 1 Platoon	1 Volcano	2 MICLICs 2 ACEs 1 Platoon	LD to PL San Antonio
2 MICLICs (reduce) 2 Plows (reduce) 2 ACEs (proof) 1 Platoon (mark lanes)	0 MICLICs 2 Plows 2 ACEs 1 Platoon	1 Volcano	2 MICLICs 2 ACEs 1 Platoons	1st Belt (security zone)
0 MICLICs 0 Plows 0 ACEs 0 Platoons	0 MICLICs 2 Plow(reduce) S ● ● 2 ACEs (proof) 1 Platoon (mark)	1 Volcano	2 MICLICs (reduce) 2 ACEs (proof) 1 Platoon (mark lanes) *no redundancy (risk)	2nd Belt (main battle area)

Figure 1. Minimum Critical Resources at Breach Site.

In this example, Task Force (TF) 1-16 has two MICLICs, four plows, two ACEs, and two engineer platoons before it begins breaching operations in the first obstacle belt. The task force marks one scatterable minefield between the line of departure (LD) and Phase Line (PL) San Antonio and creates two lanes in the first belt or security zone. Mobility assets from the engineer reserve create two lanes in the second obstacle belt. If the M-CRABS are not available, the maneuver commander proceeds to the point of breach with great risk.

Engineer Mobility Reserve. To successfully reduce enemy obstacles, the commander requires detailed information on their size, orientation, and composition. Is there a tank ditch in front of or behind the minefield? What is the minefield depth, length, and orientation? Are there antitank and/or antipersonnel mines? If so, how are the mines dispersed in depth and across the front? Answers to these questions are vitally important when planning breaching operations, but unfortunately they often are not available until just before or during the attack, if at all. If key information is not available, it may help to form a mobility reserve that can provide the commander flexibility when responding to changing situations on the battlefield. As the intelligence and the battle develop, the brigade commander may decide to commit the mobility reserve to the task force breaching the obstacle.

Composition of the mobility reserve will vary depending on the amount of intelligence gathered and the size of the obstacle that planners anticipate. Planners may decide to form the reserve from engineers habitually attached to, or under the operational control (OPCON) of, the task force providing support. Using a platoon as the mobility reserve provides the command and control necessary when the reserve assignment changes from brigade to maneuver battalion. The mobility reserve will require reduction assets such as MICLICs and ACEs.

There is no doctrinal method to command and control the mobility reserve. Since this element is a brigade asset, the engineer battalion operations officer (S3), who understands the entire brigade plan, is a good choice to initially command and control it. At some point in the battle, the brigade commander may change the task organization and assign the mobility reserve to one of the battalion task force elements. The engineer platoon leader of the mobility reserve then begins working for the task force. Therefore it is important that the mobility reserve, or at least key representatives from this element, participate in the brigade and battalion rehearsals. After the mobility reserve reverts to task force control, the engineer battalion S3 provides additional "eyes" for the brigade at the point of breach.

Despite the absence of intelligence information, engineers must plan in detail for commitment of the mobility reserve. Even if planning is based on an enemy situation template, detailed engineer planning will facilitate a decision process that is based on well-thought-out trigger points for executing important decisions. The timing of decisions to move breaching assets is key to the outcome of the battle. M-CRABS provide the analysis that supports construction of a simple decision support template (DST) (see Figures 2 and 3, page 24).

Decision Support Template. A DST helps commanders identify trigger points for key decisions concerning when to move the mobility reserve forward or when to move tank plows from

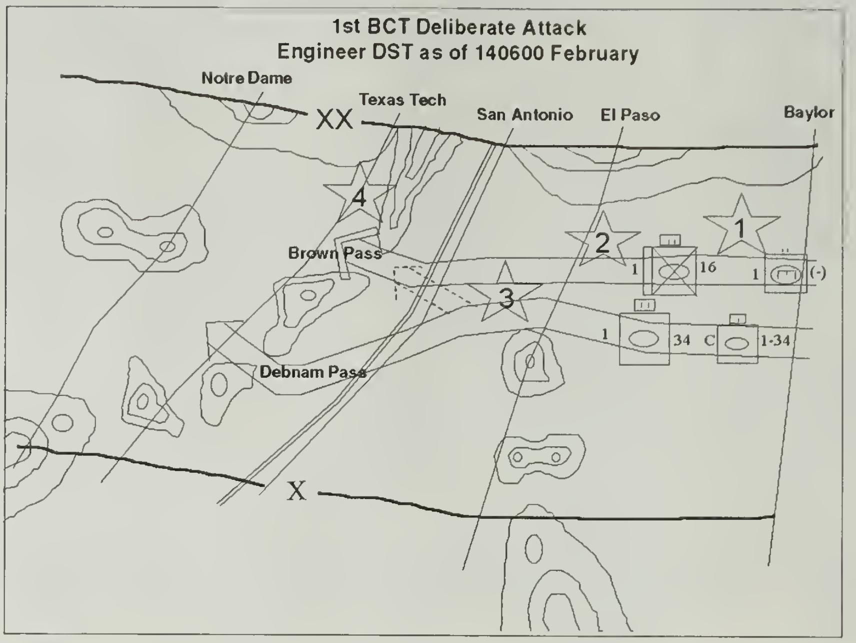


Figure 2

Engineer Decision Points

Decision Points	Events	Decisions and Critical Events
1	Engineer recon team disabled or destroyed	1. Send second recon team. 2. Replace dismounts with mounted team, if team is capable. 3. Recover vehicles and evacuate casualties.
2	Maintenance/combat losses prior to PL El Paso	1. TF 1-16 must retain 2 MICLICs, 2 plows, 2 ACEs, and 2 engineer platoons or obtain reinforcements. 2. Reinforce with mobility reserve and 2 MICLICs.
3	Brigade commander decides to breach north or south	1. If north, mobility reserve is OPCON to TF 1-16. 2. If south, mobility reserve is OPCON to TF 1-34. 3. Trail task force battle position to support breach with 2 plows.
4	Initial breach complete across PL Texas Tech	1. Assault force must retain 2 MICLICs or 2 plows. 2. Mobility reserve becomes OPCON to TF 1-34 with 2 MICLICs or conduct reload operations; continue attack with risk and 2 plows.

Figure 3

an uncommitted unit to one needing mobility assets. Figure 3 shows the timing of key decisions to shift engineer assets based on M-CRABS. For example, if there are maintenance or combat losses at decision point 2 that reduce TF 1-16's reduction assets below those shown in Figure 1, the brigade commander may decide to commit the mobility reserve, including an engineer platoon with two MICLICs and two ACEs. If there is no change in task organization of the mobility reserve, the brigade commander will arrive at another decision point after PL El Paso. Then he must decide to commit the mobility reserve to either TF 1-16 to breach in Brown Pass or to TF 1-34 to breach in Debnam Pass. At decision point 4, the brigade commander must decide whether to continue with the attack or pause to refuel vehicles and reload the MICLIC.

The Battle of Brown Pass. At the NTC, the opposing force (OPFOR) defeated the 1st BCT during its deliberate attack through Brown and Debnam Passes. All friendly scouts were dead, so the brigade had no "eyes" forward. The lead task force could not destroy the enemy on the far side of the obstacle. The OPFOR, which was overlooking the obstacle, destroyed all engineers during breaching operations.

In a repeat battle, the 1st BCT was successful. This time, an engineer scout team walked more than 10 kilometers into position at Brown Pass and provided the brigade's only "eyes" as it began to attack. The brigade commander decided to attack through Brown Pass because Debnam Pass was heavily fortified (there were no "eyes" in that pass). At decision point 3, the brigade commander changed the task organization by making the mobility reserve OPCON to TF 1-16. The engineer scout team called for indirect artillery fire, which destroyed most of the enemy positions on the far side of the obstacles. When the lead engineer commander's vehicle was destroyed, he took his backpack radio and moved to high ground near the breach site. The TF 1-16 commander spotted the enemy's combined arms reserve, but due to intense fighting, he was not in position to call for air support. The engineer commander, who oversaw the breaching operations, helped identify the exact location of the enemy reserve. Then friendly air support destroyed it. Assault forces pushed through the breach and ultimately destroyed every OPFOR vehicle. The brigade won the difficult battle of a deliberate breach on the reverse slope of Brown Pass.

Using similar techniques during a later battle at the NTC, the mobility reserve successfully completed breaching operations with one task force and then moved to a location 10 kilometers north. The reserve linked up with another task force and began breaching operations without delaying the attack. Without well-planned decisions on moving and commanding and controlling the critical assets, shifting these resources would have been extremely difficult. M-CRABS and DST cards, handwritten or computer-generated, can facilitate decisions by helping commanders "see the battlefield."

Defensive Operations

During defensive operations, the focus of effort is on engineers—from digging survivability positions to building obstacles for engagement areas (EAs). Two key lessons often learned at the NTC are the importance of starting the engineer effort early and the need to efficiently and accurately track the battle.

Begin the Engineer Effort Early. This is a two-edged sword. A hasty start may result in work that does not contribute to the task force plan. Usually the task force does not develop its plan before nightfall, and attempting to site obstacles and direct-fire systems in the dark is ineffective. Having to wait for the task force to develop a plan often results in countermobility/survivability assets remaining idle for several hours. Various solutions to this problem would allow engineers to initiate work effort in areas that will ultimately support the task force plans. Options include digging survivability positions for artillery, mortar, and command and control systems. These missions are valuable for the defense, but the highest priority mission is to develop the EA with obstacles and survivability positions for direct-fire systems.

A brigade-directed obstacle group and battle position (BP) facilitate rapid emplacement of obstacles or survivability positions, but they must support the brigade's scheme of maneuver. The task force's ultimate plan should include the brigade-directed obstacle group and BP. When the task force is ready to execute its plan, engineers should have very little work remaining on their brigade-directed task.

Key players involved in a brigade-directed obstacle group and BP must meet on the ground to resolve differences before work begins. Key individuals may include the task force/company team commander, the fire support officer, the S2, the engineer, and others. The brigade commander will help clarify their understanding of the mission by explaining his intent at the site of the brigade-directed obstacle group and BP. This meeting, which should occur immediately after the operations order briefing, is perhaps the last time the group can assemble before nightfall.

Track the Battle. The second area of importance during the defense is tracking the progress of defensive preparations. Many units track defensive preparations using detailed charts that require an engineer to explain them.

The 1st Armored Division Engineer Brigade in Germany experimented with various methods to graphically track and portray progress in defensive preparations. While in the division tactical assault center one night, the division commander called the operations officer (G3) for an update on defense preparations. The G3 walked over to the engineer battle-tracking board, removed a countermobility/survivability chart (similar to Figure 4, page 26), and began to update the division commander. It was clear that maneuver elements could easily communicate information using this chart. Engineers in the 1st Engineer Battalion S3 and assistant brigade engineer sections helped refine this system of reporting prior to and during two NTC rotations.

The countermobility/survivability tracking chart is simple but includes enough details to give the commander a complete picture of defensive preparations. Using this chart, the brigade staff can efficiently track defensive preparations and start and completion times, and the commander can better understand

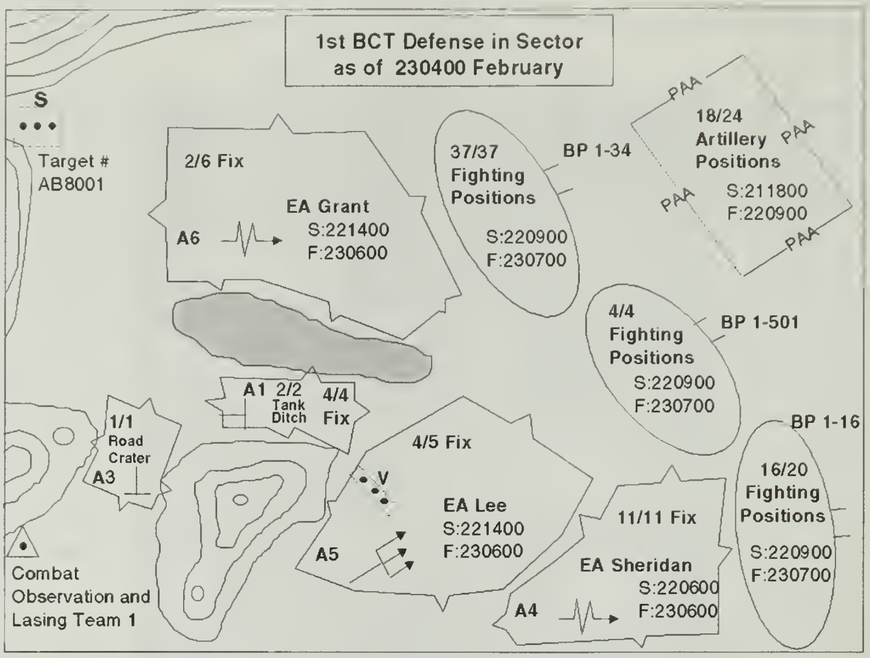


Figure 4

when and which engineer assets to shift to support his intent. For example, in Figure 4 (as of 0400 hours on 23 February, in obstacle belt A6) only two of the six planned obstacles were completed. In BP 1-34, which covered that obstacle, all of the 37 planned fighting positions were completed, while 16 of 20 planned positions in BP 1-16 were completed. Start and finish times on the tracking chart help Tactical Operations Center (TOC) personnel track the battle. Battle tracking helps commanders understand planned versus actual engineer work effort and the approximate time when they will receive engineer assets.

TOC personnel must know the commander's key decision points. When he is asleep, planners or subordinate commanders must know which trigger points require that someone awaken him for a decision. In this particular defense (Figure 4), the brigade commander decided to move additional engineer platoons to Belt A6 and additional digging assets from BP 1-34 to BP 1-16. The logic for these decisions was based on information depicted on the countermobility/survivability chart.

The brigade, task force, and engineer commanders carry similar countermobility/survivability cards. Their TOCs track the defensive preparations in the same manner. By using these cards, staffs can update the commander and higher command posts quickly, efficiently, and accurately. A report from the TF 1-34 commander may be simply "Status of defensive preparation follows: Two of six obstacles were completed in Belt A6, and 37 of 37 positions were completed in BP 1-34."

The countermobility/survivability chart works well for developing a common understanding of the overall defensive plan and progress, but engineers must maintain more detailed battle-tracking information, such as the start and end points of specific minefields. During this particular battle, the brigade built an unprecedented number of obstacles (more than 3,000 mines, two tank ditches, and more than 75 vehicle survivability positions). The battle ended at 2000 hours on 23 February. The final disposition re-flected the success of the brigade's defensive preparation: no enemy penetration of friendly positions and every enemy vehicle destroyed.

Conclusion

Facilitating command and control through better battle tracking in both offensive and defensive operations is a combined arms team effort. Each member of the team must understand and work to achieve the commander's intent. Staffs at all levels can help commanders "see the battlefield" and make informed decisions. Good battle tracking through clear, efficient, and understandable processes provides the commander with the "eyes" and information necessary to make key decisions with confidence and success.

Colonel Bostick is Commander, 1st Armored Division, Division Engineer, Germany. He previously commanded the 1st Engineer Battalion, served as a planner with USAREUR DCSENG, was a White House Fellow, and served as executive officer to the Chief of Engineers. COL Bostick is a graduate of the U.S. Military Academy and the U.S. Army War College and holds master's degrees in mechanical and civil engineering from Stanford University.

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Book Review

Stormtroop Tactics: Innovation in the German Army, 1914-1918, by Bruce I. Gudmundsson, Praeger Publishers, Westport, Connecticut, 1989, 210 pages.

The stunning German *blitzkrieg* campaigns of early World War II were in part the product of their experiences in World War I and of a Prusso-German military culture stretching back through Moltke the Elder (1800-1881) to the great military reformers of the Napoleonic era (Scharnhorst, Gneisenau, and Clausewitz). This tradition encouraged small unit leader initiative, flexibility, risk taking, and relative military open-mindedness.

With the onset of stalemate on the western front late in 1914, the Germans began to experiment with various means of breaking the deadlock of trench warfare. These experiments included unrestricted submarine warfare, strategic bombing, massed artillery fire, and new tactical techniques based on several siege warfare innovations. The innovations were the domain of the German pioneers (combat engineers). After much experimentation, the most effective innovations were combined to create the "storm-trooper tactics."

The author traces the origin and development of German storm-trooper tactics (sometimes incorrectly referred to as *infiltration* or *Hutier tactics*) from 1914 until the end of the war. The many technical innovations introduced by the pioneers included the first use of modern grenades, trench mortars, man-packed flamethrowers, chemical warfare, and, belatedly, the first German tanks. These innovations, combined with the tactical flexibility inherent in the pioneer corps, resulted in the development of highly effective combined arms teams at company and battalion levels. The reasons for the somewhat surprising contributions of the pioneers are described by the author:

> *The reasons that the German pioneers, rather than line infantry, were able to innovate so quickly are many. In 1914, the pioneers were already used to working, with very little supervision, in squad sized teams. Pioneers were trained for fortress warfare before the outbreak of hostilities. This gave them a head start in thinking about the problem of crossing "no man's land," which, after all, is an easier proposition than crossing the glacis of the masonry fortress, as well as providing them with the tools, particularly hand grenades, of trench warfare. Pioneers were, moreover, free of romantic notions of battle. War to them was a dangerous job, like the digging of a mine or the building of a bridge over a fast-moving river. Martial virtue consisted of finding the most efficient way of doing the job, not in the beau geste of a bayonet charge. Finally, pioneers, whose training in prewar infantry tactical forms was not as thorough as that of the infantry, had fewer bad habits to break.*

The first and most famous of the storm-trooper units, Sturm Battalion Rohr, was named after its commander. It was formed in 1915 from the replacement companies of two pioneer battalions of the 8th Corps and a flamethrower detachment from the 3rd Guard's Pioneer Battalion. Many more storm-trooper units were formed later, primarily from pioneer and Jager (light infantry) units. Storm troopers spearheaded attacks at Verdun, Cambrai, Riga (in Russia), the 12th Battle of the Isonzo, and the German "Peace Offensives" of 1918. German storm troopers were able to restore operational maneuver to the deadlocked western front by using flexible, dismounted infantry tactics at the same time that the allies were turning to the tank. Because the German army was unable to logistically support the storm troopers after they had broken through allied lines in 1918, they were unable to exploit their tactical successes.

Combat engineers should find this book to be fascinating reading. It is recommended to all combat arms leaders.

Major William C. Schneck, Assistant Division Engineer, 29th Infantry Division, Virginia Army National Guard.

Maintaining Engineer Equipment

By Major Charles Radke

In his "State of the Engineer Branch 1997" (*The Army Engineer*, June 1997, page 20), MG Clair F. Gill, then commandant of the U.S. Army Engineer School, asked that we help move the branch forward into the next century. He presented seven challenges to remember as we go about our daily activities. Challenge number four was "Maintain your equipment to standard and train your soldiers to use it to its full effectiveness." MG Gill explained why this is important and tried to influence maneuver commanders to voice their concerns about engineer equipment.

Maintenance Imperatives

That challenge reminded me of my experiences as executive officer in an engineer battalion deployed to Bosnia and Herzegovina. The following information includes some of the items I believe are necessary for a successful maintenance program. The Army Maintenance Management System describes other requirements in DA Pamphlet 738-750, *Functional Users Manual for The Army Maintenance Management System (TAMMS)*. Additional requirements in local SOPs and regulations help ensure successful maintenance operations. The imperatives in this article were extracted from several of these documents.

Manage repair parts load lists to maximize on-hand parts. Prescribed load lists (PLLs) are automated in the Unit-Level Logistics System (ULLS). Stockage is based on demands (as required by Army regulations) and on monthly inventories conducted by parts specialists. Insist that the PLL clerk record parts used and then double-check the availability of each part monthly. Parts that receive fairly regular demands must be stocked in the PLL. When authorized, keep on hand at least two of each item in the PLL to avoid a zero balance.

You must manage quick-service-supply, low-cost items (under $25) that can be retained and do not count against PLL ceilings. Know what you have on hand, organize it, and make it accessible to users. If small parts from a set, kit, or outfit are at zero balance, order replacements immediately. O-rings, bolts, connectors, and hardware are just as important to have on hand as new starters.

Participate in authorized stockage list (ASL) review boards and insist that

Instead of running this ACE to maintenance without its track, a plan was executed to move it as shown here and not cause additional damage.

Maintenance in the mud should be anticipated. Truck-mounted shop equipment and a trailer-mounted hydraulic fabrication set help accomplish the maintenance mission.

the ASL of the direct support unit (DSU) supports your repair parts stockage and is tailored to support engineer equipment. Army regulations allow ASLs to stock repair parts for low-density equipment (like engineer equipment) on the basis of "three demands to add and one to retain." Regulations require that "nine to add and three to retain" criteria be used for more common parts. Help the DSU identify the low-density equipment repair parts you need. Most major assemblies (such as engines, tracks, road wheels, and transmissions) are stocked and carried at the DSU. It took 25 to 30 days for parts to be shipped from CONUS to Bosnia. If the DSU did not have a major assembly on hand, we had at least a month of nonmission-capable (NMC) time.

Don't collect excess repair parts, whether serviceable or unserviceable, because they take up valuable space and require a separate management system. Turn in unserviceable parts and get them into the rebuild program. Also turn in unauthorized serviceable parts. You may need them someday, but let the system hold them until then.

Manage each part that makes a piece of equipment NMC—from diagnosis through installation. Order the right part the first time. In Bosnia we let organizational maintenance personnel identify deficiencies and establish requirements for parts. Then, we managed the required parts by exception. If parts requests were passed to the wholesale supply system, experienced personnel reviewed the problem to ensure that the correct part was ordered. Usually the battalion's maintenance technician, sergeant, or officer performed the task, but sometimes it was a technician from the Logistics Assistance Office, the DSU, or a contracted maintenance advisor.

Once a repair part is ordered, a record of the request is in the repair parts system. Important items to verify are stock numbers, nomenclature, quantity ordered, unit of issue, acquisition advice (one of the most commonly disregarded codes), urgency-of-need designator, and required delivery date. If the delivery date block is left blank, regardless of priority, there is no NMC request in the system.

Periodically check the status of the request at the unit and take the necessary action. Now that the entire Army operates on ULLS and the Standard Army Retail Supply System-Objective (SARSS-O), a maintenance supervisor can quickly determine if parts have been ordered and if requests have been passed to the next higher level of supply. The request is printed on the Maintenance Inspection Worksheet 5988-E and includes a list of parts on order for the equipment. Both the ULLS and SARSS-O must exchange information daily to ensure that valid requisitions get into the system. If the ULLS status is incorrect, something is wrong with the human side of the system and must be corrected.

Follow parts from the source of supply through delivery to the equipment. Requests are quickly established in the wholesale supply system, and the status is returned just as quickly. DSU operations personnel can determine the status of all requests and speed a shipment or solve problems. They also maintain contact with the entire supply infrastructure, which was developed to fix problems as they are identified. With modern tools such as "Total Asset Visibility" and "In-Transit Visibility," we can determine when a part arrives at the local parts warehouse. If necessary, means are available to quickly get the part from the warehouse to the equipment.

Train operators, maintenance and supply personnel, and supervisors on maintenance and operation of engineer equipment. Training operators saves time and saves equipment from operator-induced failures. Training is often performed at the unit level, but formal training elsewhere is available. Begin operator training with a well-structured drivers' training program. Once soldiers know the correct methods of maintenance and operation, *"Once soldiers know the correct methods of maintenance and operation, they usually follow proper procedures."*

they usually follow proper procedures.

Maintenance personnel in a division receive training from the Maintenance Assistance and Instruction Team and other sources. Logistics Assistance Office personnel, the local representatives from the Army Materiel Command, are positioned forward to provide training assistance.

Personnel who supply repair parts also require training. Regardless of their military occupational specialty, well-trained parts specialists and assistants are cornerstones of maintenance management.

Current engineer doctrine places the company first sergeant in the role of maintenance support supervisor. To perform this function, NCOs must be trained on the entire maintenance process as they move through the echelons of leadership. Training to go beyond the company and battalion to solve maintenance issues must be instilled early. Then, when small units are away from the parent unit, the NCO supervisor can continue a maintenance program.

Fabricate repair parts locally to save time and money. In Bosnia, the engineer battalion was the conduit for the fabrication of repair parts for the brigade combat team. A hydraulic shop and two machine shops were under contract. In addition, our fully stocked shop van, welding outfit, and hose-fabrication outfit made many items quickly, saving transportation costs. Nearby aviation maintenance units usually are an excellent source for hydraulic hose fabrication.

Perform periodic services on time and to standard. Technical manuals, lubrication orders, and regulations provide the standards. Don't forget to check out-of-sight items (such as weapons; night-vision devices; and nuclear, biological, and chemical equipment) when scheduling and completing services. Task organize maintenance and engineer units to complete a block of services. When one leader is given the responsibility, time, and tools to complete a service mission, the results are very close to optimal. The overarching goal of periodic service is to have equipment leave the service process in like-new condition. Make every effort to identify problems and institute corrective actions. Ensuring that parts are on hand for scheduled services requires a well-planned, systematic ordering process. If the wheel seal needed during scheduled services is not on hand, chances are it will never be installed.

Complete, document, and correct problems identified during periodic checks. Some maintenance checks are listed in technical manuals for the equipment, and others come from Army safety regulations. Each set of guidance specifies that checks be performed before, during, and after operations. Too often, maintenance checks consist of a quick walk around the equipment and starting the engine. It's better to put an entire weapon system together and run it through normal operation. Put the weapon on the vehicle, turn on the communication devices, and move the system to complete all required checks. If an operator identifies a problem during the checks, maintenance personnel must correct it without delay.

Exercise equipment to help identify problems and keep it fully mission capable (FMC). Equipment stored for any length of time begins to deteriorate. Seals lose resiliency, rubber rots, electrical connections corrode, and rust invades spaces that should be clean. Our equipment in Bosnia hit record highs in terms of miles and hours but continued to stay FMC. One reason was that by operating complete systems often enough to prevent deterioration, we helped prevent early component failure.

Plan well and consistently enforce standards to ensure safe maintenance operations. Planning ensures that standard procedures are in place to reinforce the safety program. Include detailed procedures for inflating split-ring wheels, backing vehicles, handling hazardous material, and operating the shop. After policies are established, enforce them. Also enforce common safety rules. Safety is a force multiplier, and maintenance operations are one of the biggest benefactors from this practice.

Maintenance Success

With successful maintenance practices established, our battalion followed the directive to deploy to Bosnia only equipment that could shoot, move, and communicate, and that could self-load onto the rail cars. After the equipment arrived in Hungary, we road marched to Croatia and drove every vehicle across the Sava River to a remote base camp. Our battalion accomplished this trip without leaving anything in Germany and without borrowing replacements from other units. In Bosnia, we enjoyed higher-than-average readiness rates even though we logged additional miles and hours.

Maintenance imperatives are long-term events. Getting started on them as soon as possible will lead to earlier success. Perhaps the imperatives described above will help satisfy MG Gill's challenge to "Maintain your equipment to standard and train your soldiers to use it to its full effectiveness."

Major Radke is assigned to the Concepts Division, Directorate of Combat Developments, U.S. Army Engineer School. Previous assignments include executive officer, 9th Engineer Battalion, 1st Infantry Division, Bosnia and Herzegovina; and chief of automation for logistical systems, 3rd Infantry Division Support Command. MAJ Radke is a graduate of the Armor Officer Advanced Course, Systems Automation Course, and the Command and General Staff College.

Mission Analysis:

Getting It Right

By Major Joey Wyte

With the battle rhythm in place, the brigade staff initiates planning for an upcoming deliberate attack. The brigade S3 tries to keep to the established timeline. He rips annexes from the division operations order and passes them to his staff, instructing them to "conduct your mission analysis and provide your input to the battle captain." With annex in hand, the brigade engineer returns to his work station, gives the annex a cursory look, conducts his mission analysis, and passes his input to the battle captain. The time spent was less than 15 minutes.

At the Joint Readiness Training Center (JRTC), Fort Polk, Louisiana, task force engineers at brigade and battalion levels often experience difficulties with providing mobility/survivability input to the military decision-making process (MDMP). Due to the MDMP's logical sequence, engineer planners must get it right from the beginning. This means they must correctly identify and integrate the specified and implied mobility/survivability tasks during their initial mission analysis.

Engineer Planning

Engineers who participate in the MDMP usually rely on tasks specified in the higher headquarters operations order as the primary source of input for their mission analysis and seldom focus on the mobility/survivability battlefield operating system (BOS). Our maneuver counterparts, who facilitate the MDMP, often say, "How are you going to get your dog in the fight?" This phrase tends to focus engineer planners on engineer-specific tasks rather than mobility/survivability tasks. Understanding the difference between the two will ensure that critical tasks are identified and integrated into the overall plan.

The question isn't how to get "your" dog in the fight as much as it is how to get "the" dog in the fight. Instead of viewing the MDMP as a function of a particular BOS, engineer planners (as well as other BOS representatives) see the "dog" as a specific unit. Hence, task force engineers at the JRTC often provide the same generic input, which is directed entirely at engineer units. The result is a one-sided approach to identifying tasks.

Table 1 shows common phases of an operation and helps illustrate the input routinely provided by engineer planners. Because the MDMP is sequential, the lack of detailed input directly influences other steps of the decision-making process, including the staff's ability to fully synchronize courses of action (COAs). An insufficient mission analysis normally leads to an incomplete COA. Therefore the engineer planner must analyze the mission from a mobility/survivability perspective. Although Table 1 addresses critical mobility/survivability tasks, it doesn't fully identify those that maneuver units must accomplish. Experience at the JRTC shows that when critical mobility/survivability tasks are not specified—either from a higher headquarters operations order or as a result of mission analysis at the brigade or battalion level—those tasks are not incorporated into the COA. This subsequently leads to critical tasks not being included as an event during the "action, reaction, counteraction" drill of wargaming. The end state is a desynchronized plan that often leads to disastrous results for the unit and the "dog" never making it to the fight.

Table 2, page 32, highlights the multiple mobility/survivability tasks that can be associated with any operation, regardless of the mission, and the type or level of maneuver unit responsible for executing them. This method of analysis stresses the function of the mobility/survivability BOS and is not limited to a specific type of unit. Analyzing the mission from this perspective creates several ways to get the "dog" in the fight. The input does not address only engineer tasks but identifies tasks the brigade and battalions must execute as a combined arms team.

Table 1. Generic mission analysis input directed at engineer units

Phase I (Reconnoiter and Set Conditions	Phase II (Conduct Air Movement)	Phase III (Attack)	Phase IV (Consolidate and Reorganize)
☐ Conduct precombat checks and inspections. ☐ Rehearse battle drills.	☐ Conduct air assault.	☐ Conduct assault breach.	☐ Provide countermobility support.

Table 2. Mobility/survivability tasks associated with any mission.

Phase I (Reconnoiter and Set Conditions)	Phase II (Conduct Air Movement)	Phase III (Attack)	Phase IV (Consolidate and Reorganize)
☐ Identify possible main and alternative routes (MSR and ASR). ☐ Recon MSR/ASR. ☐ Recon axis of advance. ☐ Locate and identify enemy obstacles along MSR. ☐ Identify enemy battle positions and supporting tactical obstacles. ☐ Identify and locate possible bypasses. ☐ Recon landing zone (LZ) and pick-up zone.	☐ Conduct air assault. ☐ Secure primary LZ. ☐ Clear alternate LZ.	☐ Confirm or deny the presence of obstacles along MSR and axis of advance. ☐ Conduct in-stride breach and bypass obstacles. ☐ Conduct assault breach. ☐ Conduct route clearance. ☐ Employ scatterable mines to isolate and fix counterattack.	☐ Employ hasty protective obstacles. ☐ Prepare hasty fighting positions. ☐ Establish tactical command posts. ☐ Upgrade minefield-marking systems on reduced obstacles.

Engineer and maneuver staff planners must realize that a mobility/survivability task does not necessarily equate to an engineer-specific task. The brigade has at its disposal a variety of assets—such as scouts, long-range surveillance detachments (LRSD), and aviation and maneuver companies—to help accomplish the mobility/survivability tasks. For example, scouts and LRSD are tasked to confirm or deny enemy obstacles, while aviation assets conduct aerial recons to determine the suitability of main supply routes (MSRs) and planned axes of advance.

By applying the methodology in Table 2, engineer planners focus on the function of the BOS and ensure critical mobility/survivability tasks are identified, addressed, and synchronized in the tactical plan. This forces the brigade and battalion staffs to consider using a wide variety of assets without relying solely on engineer units. The end result equates to a more detailed maneuver plan and highlights the necessity for proper implementation of limited engineer assets.

Engineer Annex

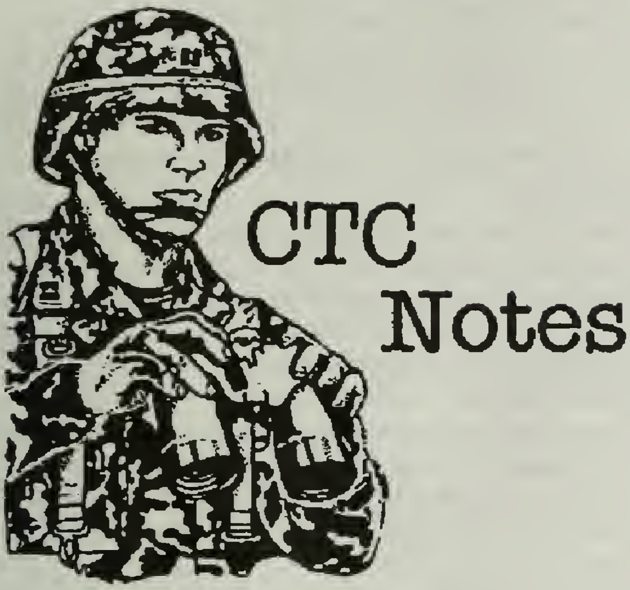
A product of the MDMP, and closely associated with mission analysis, is the engineer annex. A developing trend at the JRTC revolves around how input to the engineer annex is addressed. Engineer staff planners continue to use the annex as the primary means to task engineer units (versus maneuver units) with specific engineer tasks. The engineer annex is where maneuver units should go to seek additional information and tasks related to the mobility/survivability BOS that are not covered in the base operations order. However, the engineer annex is consistently viewed as a source of information useful only to engineer units. To compound the problem, engineer leaders view the engineer annex as their version of an engineer operations order. Hence, they use this as an excuse for not issuing detailed operations orders at company and platoon levels. This shortcut fails to use the annex as the primary tool for addressing specified mobility/survivability tasks for maneuver units, as identified during mission analysis.

Key to Success

Success of the MDMP—and the unit—depends on a complete mission analysis. If we persist in viewing our piece strictly from an engineer perspective, critical mobility/survivability tasks will continue to be overlooked and will be absent during the MDMP. As task force engineers and staff planners, we must learn to distinguish between the need for engineer advice and the need for advice pertaining to the function of the mobility/survivability BOS.

To ensure our success as members of a combined arms staff, engineers must gain a better working knowledge of the MDMP and understand the importance of comprehensive mission analysis. This includes broadening our vision and providing input based on the function of the mobility/survivability BOS. If we overcome the temptation to see the fight just from an engineer viewpoint, then the "dog" stands a better chance of not only getting to the fight but also of winning.

Major Wyte is the Chief, Engineer Plans and Operations Section, and served as the Engineer Company Senior Observer/Controller at the Joint Readiness Training Center. He has completed tours with the Royal Australian Engineers, 10th Mountain Division (Light), and the 9th Engineer Battalion (Corps, Mechanized).



CTC Notes

Battle Command Training Program

By Lieutenant Colonel Aaron Bush

Every year the Battle Command Training Program (BCTP) publishes perceptions for each battlefield operating system (BOS). Engineer and chemical perceptions are combined into mobility and survivability BOS. The 1997 mobility/survivability perceptions are basically the same as those identified in 1996. Engineer commanders and staffs should keep in mind that mobility/survivability perceptions focus on key items that contribute significantly to mission accomplishment for corps and divisions. This does not mean that units are not working hard to solve these problems, because the perceptions address very difficult tasks that present challenges to every newly assembled staff. During the past 18 months, I have seen tactical and technical expertise at all levels. The soldiers, noncommissioned officers, and officers are using their expertise in conjunction with emerging technology.

Technological improvements provide great benefits for tracking, collecting, and reporting information. Most units are using computers, headsets, and telephones in very innovative ways, and the speed at which data can be transferred is impressive. But, the data remains "information" until someone analyzes it. Staffs perform analyses and then make recommendations to commanders based on the analyses.

Engineer brigade and battalion commanders must maximize the use of technology without stifling staff interaction or analysis. It should not require a captain with a degree in computer science to operate computer programs and software. If a young specialist cannot understand a computer program or the software, the staff will lose valuable time. Commanders and staffs should ask, "How does this software save us time?" or "What is the value added by using this system?" The most important question is, "How will this process help the commander?" Technology will continue to provide wonderful benefits to commanders and staffs by producing more timely and accurate information that enables both groups to do their missions.

Note: To obtain a complete copy of the 1997 mobility/survivability perceptions, call LTC Bush at (913) 684-9904 or DSN 552-9904. The e-mail address is: busha1@leav-emh1.army.mil.

Lieutenant Colonel Bush is the Mobility/Survivability BOS Chief for Team A, Battle Command Training Program, Fort Leavenworth, Kansas. He previously served as executive officer, 588th Engineer Battalion, 4th Infantry Division, Fort Hood, Texas.

Joint Readiness Training Center

By Captain John DeJarnette

The Joint Readiness Training Center (JRTC) provides light engineer companies and their supported maneuver brigade combat teams excellent opportunities to train in realistic major regional contingency and lesser regional contingency operations. Observers note that many units rotating through the JRTC have experienced difficulty in the following areas:

Observation. *Rotational brigades do not conduct mobility and survivability training as part of reception staging, onward movement, and integration operations. The result is confusion and needless mine casualties at platoon and squad levels.*

Discussion

- Vehicle drivers are unfamiliar with standard minefield lane-marking systems. Therefore, they often drive vehicles on uncleared lanes, resulting in injured personnel and damaged equipment.
- Soldiers and vehicle crews do not understand the correct actions to take when they strike a mine. As a result, additional losses occur during vehicle recovery operations and casualty evacuations.
- Minefield locations are not reported and disseminated to other units in a timely fashion.
- Battalion and brigade staff are unfamiliar with the mine-strike battle drills described in the unit standing operating procedure (SOP).

Recommendations

- Engineers construct a standard vehicle lane-marking system at entrances and exits to unit motor pools and staging areas. Leaders ensure that drivers understand how lanes are marked.
- Unit leaders conduct a mine-strike "action drill" rehearsal for both crews and unit staff. Stress individual and collective tasks as well as timely reporting in the action drill.
- Battalion and brigade staffs include mine contact and obstacle intelligence dissemination procedures in unit communication exercises.

Observation. *Engineer company SOPs are not consistent across engineer units within the same division, and they frequently conflict with the supported maneuver brigade's SOP.*

Discussion

- Many engineer companies develop SOPs that are independent of existing battalion or division standards. This practice complicates the task organization across companies that support the divisional main effort.
- The format of engineer SOP reports is not consistent with the format used by the supported maneuver brigade, resulting in difficulty using the personnel replacement and logistics systems. While differences often are minor, they are confusing.

Recommendations

Engineer battalions develop and enforce the use of one SOP for all subordinate units that are assigned or attached. The SOP should be endorsed by the division and targeted for use by the engineer platoon in support of infantry battalions and artillery batteries. The SOP should include—

- Appropriate reports and clear time lines for submitting them.
- Tactics, techniques, and procedures and battle drills for standard tasks.
- Mission-specific precombat checklists for squad and platoon leaders.
- Standard planning factors and clear standards for mobility, countermobility, and survivability operations.
- Pro forma operations orders, warning orders, and execution checklists for use by task force engineer planners.

A standard SOP that includes the above items will reduce friction at engineer squad, platoon, and company levels.

Captain Dejarnette is an engineer observer/controller at the Joint Readiness Training Center, Fort Polk, Louisiana. He previously served with the 37th Engineer Battalion, Fort Bragg, North Carolina, and as commander, B Company, 11th Engineer Battalion, Fort Stewart, Georgia.

Sergeants Major Homepage

A sergeants major homepage on the Fort Leonard Wood web site provides topics of interest to sergeants major throughout the Engineer Regiment. To date it includes information on safety, training, promotions, doctrine, equipment, quality-of-life issues, and the EN-FORCE Conference. While the homepage is up and running, your advice and suggestions for improvements are welcome. To access the homepage, access the Fort Leonard Wood homepage (http://www.wood.army.mil), click on "Leadership," and then click on the ECCSM homepage hot button under CSM Dils' photo.

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Department of Training and Doctrine Development (DOTD)

Field Manual (FM) Update. The following FMs will be available on the Engineer School's Publications homepage about 1 March (http://www.wood.army.mil/PUBS/pubs.htm). Paper copies will be distributed throughout the spring.

- FM 5-170, *Engineer Reconnaissance*, sets forth the principles of conducting engineer recon activities in support of a maneuver brigade or task force. It provides guidance on conducting enemy obstacle recons as well as technical recons such as bridge, ford, and tunnel recons. The manual supersedes FMs 5-36 and 5-30.
- FM 20-32, *Mine/Countermine Operations*, provides tactical, technical, and procedural guidance for conducting mine and countermine operations. It is presented in three parts: mine operations, countermine operations, and special mining operations. The manual incorporates recent guidance on the use of training on antipersonnel land mines.
- FM 5-428, *Concrete and Masonry*, is primarily a training guide and reference text for engineer personnel using concrete and masonry materials in field construction.
- FM 5-250, *Explosives and Demolitions*, is the technical compilation of the explosives and explosive techniques used by U.S. military forces. It provides soldiers with the ability to conduct demolition operations using the conventional detonating cord initiation systems as well as recently approved modernized demolition initiators. The manual serves as a guide to familiarize leaders with the demolition effects simulators program. It superseded TC 5-250.

POC is Lucius Warrick, -7767.

Staffing of Draft Publication. The draft version of FM 90-13-1, *Combined Arms Breaching Operations,* is posted on the Engineer School's Publications homepage (address above). Comments are due by 1 April. POC is CPT Joe Birchmeier, -7762.

Directorate of Combat Developments (DCD)

Digital Topographic Support System-Light (DTSS-L). Approval to proceed with production of the DTSS-L, which will provide commanders with tactical decision aids, was received on 9 January. Production will begin in FY 99, with fielding scheduled for FY 00. POC is Don Monton, -7970.

Feedback Page. A feedback page on DCD's homepage includes items of interest about which DCD requests readers' comments. The address is: http://www.wood.army.mil/DCD/feedback.htm. Let us know what you think about the information posted. POC is Larry Allen, -4080.

Maneuver Support Battle Lab (MSBL)

Joint Countermine Advanced Concept Technology Demonstration (JCM ACTD) II. The MSBL and Night Vision and Electronic Sensor Directorate, Fort Belvoir, Virginia, are working to execute the Army's part of JCM ACTD II. Soldiers of the XVIII Airborne Corps used novel countermine equipment to detect, report, and reduce surface and buried minefields during Joint Task Force Exercise 98-1 in January. The Close-in, Man-portable Mine Detector (CIMMD) uses a combination of a metal detector, ground-penetrating radar, and forward-looking infrared thermal imaging to locate buried metallic and nonmetallic mines. The Airborne Standoff Mine Detection System is used to detect surface and buried antitank mines. The Digital Reconnaissance System uses laser ranger-finder binoculars, the Global Positioning System, and SINCGARS to send digital mine and obstacle reports over the communications net. Another demonstration is planned for March 1998 at the Joint Readiness Training Center, Fort Polk, Louisiana. Additionally, Marines from Camp LeJeune, North Carolina, will demonstrate the equipment during a Joint training exercise in Newfoundland later this summer. POC is CPT Paul Aufschlager, -4082.

Biological Defense Experiment. The program manager, Integrated Biodetection Advanced Technology Demonstration, and the Chemical School are working with the MSBL to demonstrate a new concept in biological detection. The Distributive Biological Detection System is intended to provide warning of a biological attack. Two kinds of experiments are planned. First, the atmosphere at several installations will be sampled to determine what is normally there. Later, trials using nontoxic materials that simulate a biological attack will be conducted at Dugway Proving Ground, Utah. The experiments will test a prototype system of three technology applications. Sensor units are based on laser-particle counters, the Global Positioning System, and a telemetry system. In addition, a state-of-the-art miniature laboratory is being developed to identify biological material. POC is Mike Cress, -4083.

News and Notes

Global Positioning System (GPS) Tutorial. A GPS tutorial is available on CD-ROM from the National Imagery and Mapping Agency. The national stock number is: 7644-01-445-4559. POC is Ed Forman, Defense Mapping School, (703) 805-3215 or DSN 655-3252.

MANSCEN Construction

Visitors to Fort Leonard Wood will notice a difference in the skyline as they enter the post, due to the major construction program underway to support the relocation of the U.S. Army Chemical and Military Police Schools and related functions from Fort McClellan, Alabama. Initial planning and design for the facilities under construction began in 1995 after the Base Realignment and Closure (BRAC) Commission's recommendation to close Fort McClellan became public law.

Construction projects totaling more than $230 million will be completed at Fort Leonard Wood to support BRAC 95. In May 1997, a contract worth more than $160 million was awarded to Hensel Phelps Construction Company, headquartered at Greeley, Colorado. This contract includes a 300,000-square-foot General Instruction Facility that will provide classrooms, support facilities, and administrative areas to support officer and advanced noncommissioned officer training; an 888-person unaccompanied enlisted personnel housing complex; and a Chemical Defense Training Facility, which will provide an applied instruction area for training to identify and decontaminate toxic chemical agents. Included in the Hensel Phelps contract is the Applied Instruction Facility. This project will provide approximately 163,000 square feet of facilities to support Military Police one-station unit training and advanced law enforcement training; a Decontamination Apparatus Training Facility; and an extension to the existing Engineer Museum to store historical artifacts from the Military Police and Chemical Museums. At the end of January 1998, the Hensel Phelps contract was approximately 30 percent complete with overall completion scheduled for summer 1999.

Additional contracts were awarded in FY98 and work is underway for other facilities to support the BRAC 95 program. This work includes range modifications and a training site for military operations in built-up areas (MOBA). The MOBA site will provide a 16-building facility for training soldiers in tactics and techniques for urban operations under simulated combat conditions. Range work involves modifications to 13 static and mobile smoke ranges, pistol and shotgun ranges, and vehicle operations training areas.

Relocation activities are expected to begin during the last quarter of FY98, and all BRAC missions should be relocated to Fort Leonard Wood and fully operational by September 1999. POC is CPT (P) Mike Dunn, 596-0081.

Lead the Way

By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School

Achieving Balance

Thousands of Noncommissioned Officer Developmental Programs have been conducted and volumes of information have been written about the Army Senior NCO Centralized Promotion System and how soldiers can make it to the top. The centralized promotion system or a particular centralized promotion board are favorite topics of discussion any time two or more senior NCOs get together. Many NCOs falsely believe that doing a good job every day and waiting until they have enough time in grade are the keys to success in our promotion system. Nothing could be further from the truth. Another misconception many senior NCOs have is that high proficiency in physical training is the key to success. Some think that a college degree will ensure that next stripe. Others wrongly think that a token amount of time in a key leadership position will put them over the top. The following information explains how senior NCOs can successfully compete in the Senior NCO Centralized Promotion System.

In our down-sized, right-sized, right-functioned Army, achieving career balance will become a key factor in career progression. Balance will be important in every facet of an NCO's career: leadership, versatility of assignments, performance, potential, and military and civilian education. To be "best qualified" for promotion, an NCO cannot have specialized achievements in one or two key areas and minimum experience in the others. He or she needs significant achievements in all areas. Achieving a high degree of balance will ensure NCOs their best opportunity to make it to the top. The following examples describe NCOs who have attained a high degree of balance:

- An Advanced Noncommissioned Officer Course (ANCOC) graduate, Sergeant First Class Smith has successfully completed two years of college and is a member of the Audie Murphy Club. She is in the primary zone for the first time and has been a platoon sergeant for 2 1/2 years after serving two years as a drill sergeant. SFC Smith has received two or three "Excellent" ratings, a "1" in the potential block, and a "1" in the performance block on her last five Noncommissioned Officer Evaluation Reports.
- An ANCOC graduate, Sergeant First Class Jones has completed one year of college and was the Division NCO of the Quarter as a staff sergeant. His academic efficiency report reflects that he exceeded course standards in ANCOC. SFC Jones is in the primary zone and has served as a recruiter for three years and as a squad leader/section sergeant for three years. He currently serves as a platform instructor.

Neither of these soldiers has a blemish on his record; both have current photos in their personnel files. Both soldiers reviewed their records before the promotion board met. While it is impossible to totally describe every component of a well-balanced career, these two examples reflect excellence in every area considered by the board, and they show excellent balance in all career areas.

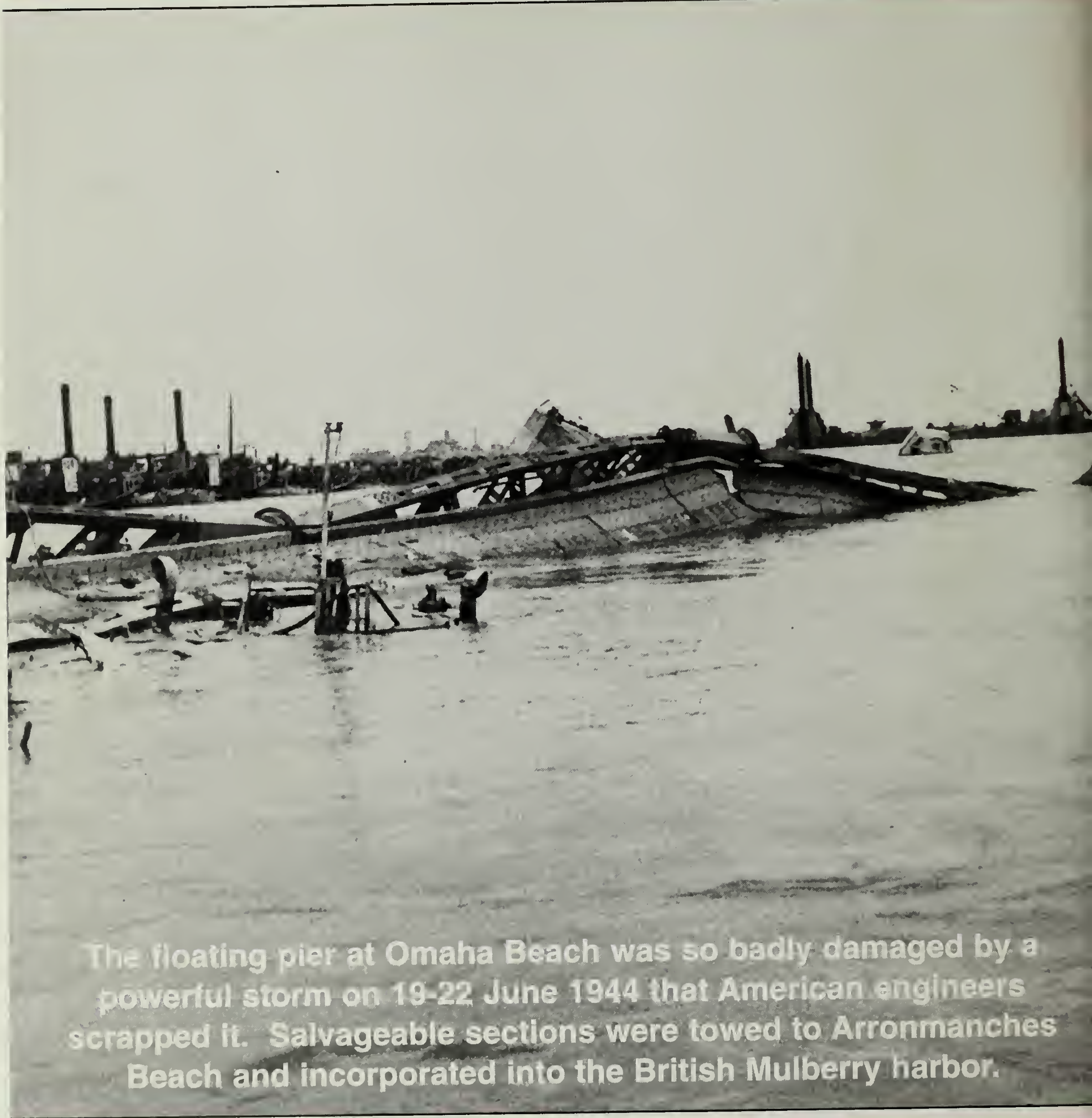
As engineer proponent, the Engineer School is responsible for providing NCO Centralized Promotion Boards with job, unit, and functional information on the various engineer military occupational specialties. We also advise the boards on the importance of the areas they will consider when determining which NCOs are best qualified. On future boards, career balance will be increasingly important. Good luck.

ENFORCE XXI-98

Planning for ENFORCE XXI-98 is moving along at a rapid pace. This year's conference promises to be the best ever, and we need your suggestions on how to make it a more valuable training tool. The Council of Sergeants Major will meet on Tuesday, 21 April, and all engineer command sergeants major are welcome to attend. I look forward to seeing you in April.

SGT Rogelio Martinez (12B20), A Company, 588th Engineer Battalion, 4th ID Engineer Brigade, is the 1st-Quarter FY98 NCO of the Quarter for III Corps and Fort Hood.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1998—655-120 / 80001



The floating pier at Omaha Beach was so badly damaged by a powerful storm on 19-22 June 1944 that American engineers scrapped it. Salvageable sections were towed to Arronmanches Beach and incorporated into the British Mulberry harbor.

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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

April 1998

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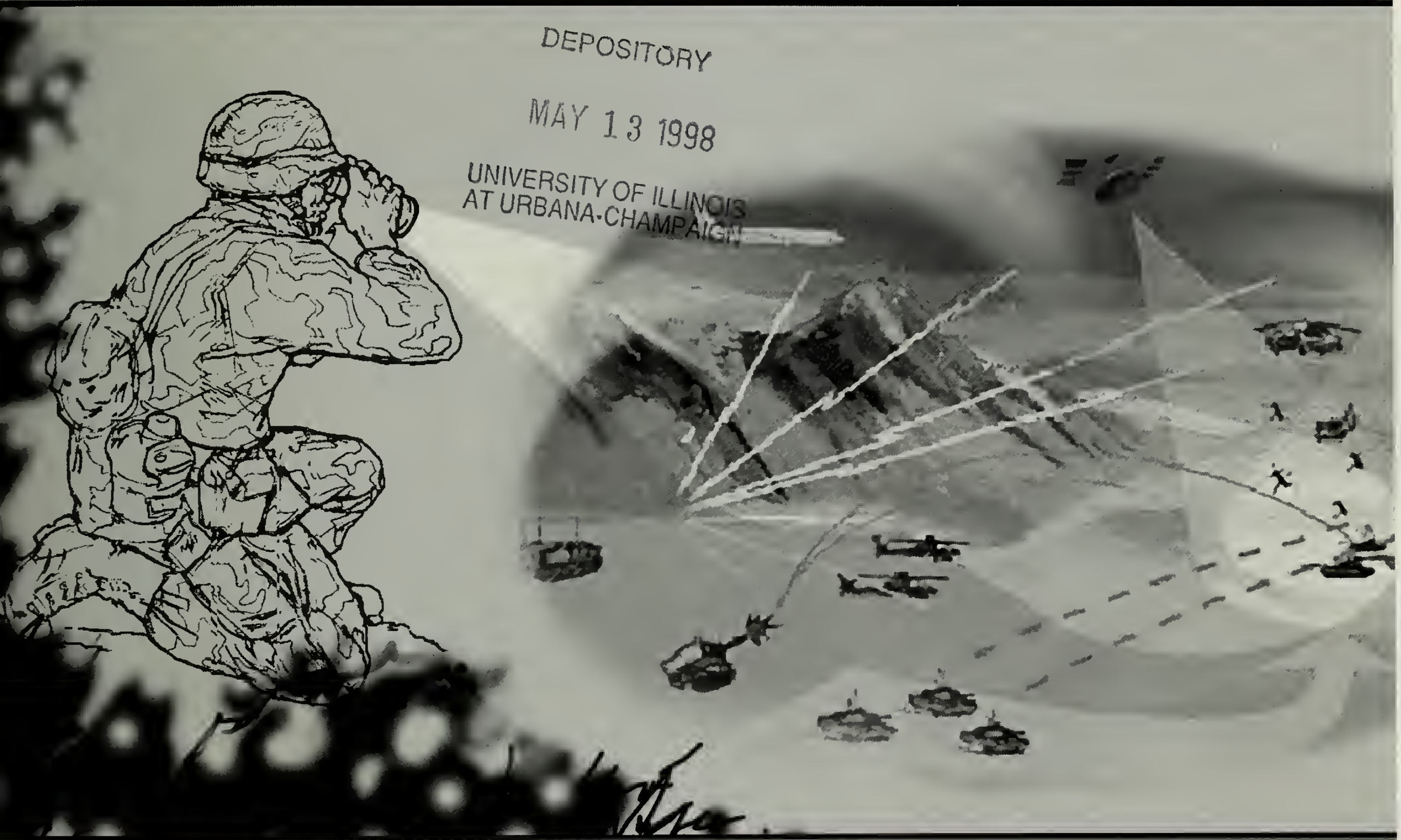

Vision 2010

Headquarters, Department of the Army
PB 5-98-2 Approved for public release; distribution is unlimited

CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

“Serving Today...Building for Tomorrow” is the theme for the ENFORCE XXI-98 conference, which is only a few weeks away. Fort Leonard Wood personnel are completing final plans as our engineer family once again prepares to gather. One of the highlights this year will be the *Engineer Twilight Tattoo,* where we will trace the military heritage of our regiment through a series of live vignettes. Based on the planning and work I’ve seen, attendance at this year’s conference will be time well spent. In spite of your busy schedules, I hope to see many of you in April. Now I will discuss our home and our Engineer Corps.

Our Home. One of the best-kept secrets in the Army and the Department of Defense is Fort Leonard Wood and the many assets it has to offer. From its beginnings in 1941, the post has been transformed from rows of wooden barracks into a modern installation with first-class facilities. Coupled with a dedicated, professional civilian and military staff, the post is quickly evolving into one of our nation’s premier places to be stationed. Visitors to our post are quick to compliment both the facilities and the professional workforce. Departing visitors now include Fort Leonard Wood on their list of great Army installations and wonder why they did not know about it earlier. My goal is for our post to be the first that comes to mind when people think of premier Department of Defense installations.

As we grow we are adding new missions. When the Military Police and Chemical Schools complete their move from Alabama, we will stand up the Maneuver Support Center [MANSCEN]. Everything is proceeding smoothly, with local communities working hard to make the transition as easy as possible. Besides adding a new wing to Lincoln Hall for these two schools, we are constructing an MP training village, a simulated decontamination training complex, and a chemical defense training facility. Along with MANSCEN, we are investigating other new missions, including Department of Defense training for humanitarian demining and testing state-of-the-art countermine technology. These and other missions will increase the value and prestige of our home.

The bottom line is that the more people know about Fort Leonard Wood, the more they like it. I want all leaders of engineers to know that, if they have time, my Protocol Office will schedule a visit for them to visit our post. I appreciate any opportunity to showcase our home and demonstrate how it supports the total Army.

Our Engineer Corps. Few professions in our society offer such diversity of assignments for both military and civilian personnel. Our country is accustomed to seeing soldiers deploy to defend democracy and Corps of Engineer civilians working long hours to overcome the devastating effects of floods and other natural disasters. Corps of Engineer civilians have deployed as part of Corps Real Estate Teams to imminent combat zones, while many combat units helped the Miami area recover from Hurricane Andrew. Civilian and military members of our Corps frequently are called to perform a wide variety of missions.

The phrase *“One Corps, One Regiment, One Fight”* is familiar to all of us, but we must avoid narrowly defining it for any one segment of our Corps. Every artilleryman can tell you how important the Crusader is, and every tanker knows that the next upgrade to the M1 tank is mission essential. Engineers, too, must speak with one voice. If we are to field new equipment and maintain vital force structure, *every* engineer must be knowledgeable about our entire Corps. To key government decision makers, there are no specialties such as active, reserve, or civilian; or light, topographic, mechanized, or combat heavy; nor do they recognize differences between our Departments of Public Works and Districts. We are all part of the Corps of Engineers. Each of us must know our profession as well as the artilleryman and the tanker know theirs. If asked, all of you should be able to clearly defend the Grizzly, the Deuce, the Digital Topographic Support System, and the latest upgrade to the Computer-Aided Drafting and Design System.

To strengthen ties across the entire Corps of Engineers, LTG Joe Ballard recently met with several of your senior leaders as a first step in writing an all-inclusive, all-encompassing “Regimental Vision.” The purpose of this vision is to clearly and simply state our priorities so that we all do speak with one voice. A draft copy will be distributed prior to ENFORCE, and we will hold a breakout session during the conference to thoroughly vet the vision. We must ensure that the concerns of the entire Corps of Engineers are properly addressed. More information will follow.

The Army Chief of Staff, General Reimer, recently began a program to highlight the seven Army core values. The Engineer Center is fully committed to embedding those values in our training. We have developed historical examples illustrating them, and one is on the back cover of this magazine. These examples can be prominently displayed throughout your unit and serve as subjects for professional development. Other examples will accompany future issues of *Engineer.*

Engineer

April 1998 Headquarters, Department of the Army ***Volume 28 PB 5-98-2***

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

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Front Cover: *Illustration by Joan Ozment. An engineer soldier views a Force XXI battlespace.*

Back Cover: *A historical example of how one engineer soldier displayed the Army value "Loyalty."*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 370, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 370, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER s e-mail address is: eubanksc@wood.army.mil. Our Internet home page is located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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The 1997 Quadrennial Defense Review

By Major General Bruce K. Scott and Lieutenant Colonel Duane Gapinski

The 1997 Defense Authorization Act required the Secretary of Defense to conduct the Quadrennial Defense Review (QDR), which examined defense requirements from now to 2015. Components of this examination included strategy, force structure, readiness, modernization, and infrastructure. The resulting report provides a roadmap for a defense program based on a well-defined strategy and fiscal realities. It describes how the Department of Defense (DoD) and the services will look in the future. While specific ramifications have yet to be determined, the end result to the Army and Army engineers can be deduced in general terms.

The DoD and the services conducted the QDR as shown in Figure 1. Each panel or task force reviewed its particular subject area using a variety of analytical tools, including the Joint Strategic Review's assessment of the world in 2005—the Joint Staff's "Dynamic Commitment" war-game series. The task forces then provided recommendations as to what the Army should look like in 2005 and how best to get there. At the integration level, senior leaders reviewed panel results and organized them into coherent options. Leaders at the highest levels (deputy or undersecretary and vice chairman/chief) supervised the entire process and made recommendations to the service secretary or secretary of defense as appropriate. The secretary of defense was the ultimate arbiter and approved DoD's report to Congress.

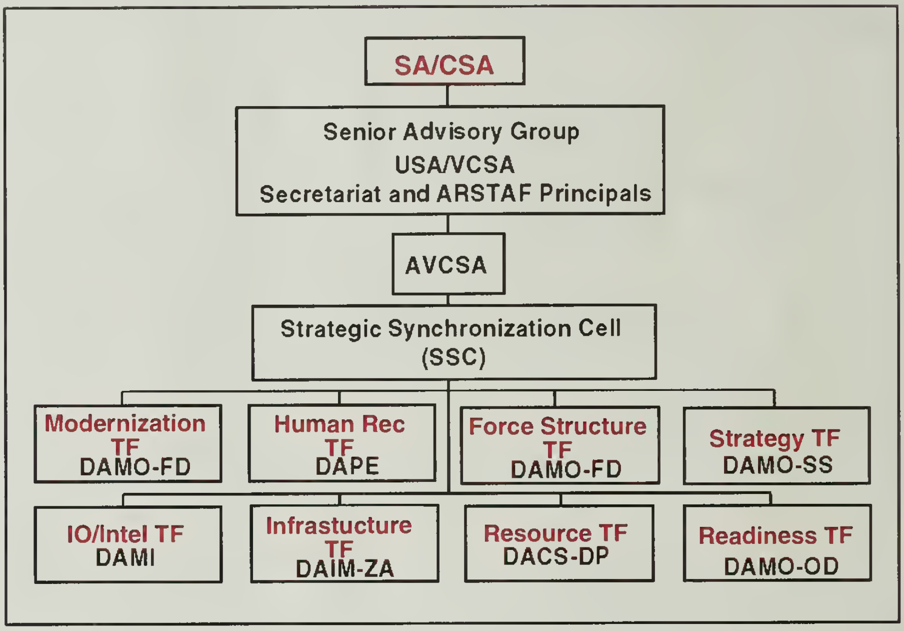


Figure 1. Army QDR Organization

During the QDR, the Army argued that the military force must be based on the National Security Strategy and the resulting National Military Strategy. The Army intended to demonstrate that the world, the National Security and Military Strategies, and resulting operational requirements had changed and that the Army had evolved in response to those changes and was making an enormous contribution in fulfilling these new requirements. The success of this argument warrants further discussion.

The Army Story

The U.S. National Military Strategy has changed to reflect requirements of the new national security environment. Military strategy is not created in a vacuum; it is derived from strategic precepts of the president's National Security Strategy of engagement. The Cold War strategy of containment led to forward deployment of a sizable portion of America's conventional forces to deter expansion of Soviet influence, primarily in Europe. Today's military strategy relies on the concepts of strategic agility, overseas presence, power projection, and decisive force to protect U.S. interests in a world that is much less predictable than its Cold War predecessor.

Today's military strategy has three critical components: shaping the international environment, responding to the full spectrum of crises, and preparing now for an uncertain future. Each component has important consequences for how military services carry out their responsibilities and how they help

US Army Corps of Engineers
Emergency Operations

Photo by Jonas N. Jordan

Mark Shores, of Charleston District, U.S. Army Corps of Engineers, oversees tree removal in Cary, after Hurricane Fran hit the North Carolina coast in September 1996.

accomplish requirements of the National Military Strategy.

On any given day of 1997, the U.S. Army had an average of more than 30,000 soldiers operating in 60 to 100 countries. That figure does not include 65,000 soldiers permanently stationed in Europe or more than 35,000 permanently stationed in Korea and elsewhere overseas. Eight years after the end of the Cold War, what are these soldiers doing in all these places, and how does what they do contribute to the construction of an international environment amenable to the strategic interests of the United States?

The past eight years have been ones of enormous change for the U.S. Army. It has transformed itself from a forward-stationed Cold War force designed primarily to conduct large-scale operations on the plains of Europe to being a power-projection force capable of rapidly delivering decisive military force anywhere in the world. The transformation came about during a period in which the Army participated in 27 operational deployments and downsized by almost 40 percent.

Perhaps the most obvious aspect of change has been the Army's reduction in size. Active Army divisions have been reduced from 18 to 10, and Reserve Component divisions have slipped from 10 to eight. Active Army personnel strength has been reduced from 781,000 to 495,000, making the U.S. Army only the eighth largest in the world, behind Vietnam and Pakistan. In 1989, there were 235,000 soldiers stationed permanently in Europe; today there are 65,000. All nuclear weapons have been removed from the Army's inventory. Budget resources have gone down 39 percent. While its physical size and structure were being altered so dramatically, the Army reconfigured itself conceptually and doctrinally to be relevant to the requirements of the new environment and the new strategy.

How does today's Army contribute to accomplishment of the nation's strategic objectives? Specifically, how does it support the three tenets of the National Military Strategy?

Shaping the International Environment

U.S. armed forces help shape the international environment through a broad range of noncombat activities that demonstrate commitment, improve collective military capabilities, promote democratic ideals, relieve suffering, and enhance regional stability. Toward these ends, thousands of U.S. Army soldiers are engaged daily in activities that promote peace and stability. Military-to-military contacts, particularly in emerging democracies of nations in the former Soviet Union, provide opportunities for U.S. soldiers to teach their counterparts everything from squad tactics to the role of the military services in a democracy. Contacts take place abroad as well as in the United States. Currently, the Army is training soldiers from 134 countries at installations throughout the United States, including Fort Leonard Wood.

Despite their reduction in numbers, soldiers permanently stationed abroad are the most visible symbol of America's commitment to its alliance partners. Forward-stationed soldiers enhance regional stability, thereby providing an opportunity for growth of democracy and economic prosperity in important regions of the world. Security assistance programs provide vital training to forces of regional security partners, thereby enhancing stability and providing a cost-effective alternative to maintaining larger contingents of U.S. forces abroad. Humanitarian operations contribute directly to stability and the reduction of human suffering. In August 1994, for example, more than 2,500 soldiers were airlifted to Rwanda to aid survivors of violent tribal conflict.

Responding to Crisis

The U.S. military will be called on to respond to crises across the full range of military operations, including deterrence, fighting and winning major theater wars, and conducting concurrent small-scale contingencies. While U.S. strategic nuclear forces remain the ultimate deterrent force, today's security environment requires a complete range of capabilities to deter potential adversaries against whom the threat of nuclear destruction may not be credible. Forward-stationed forces, particularly in Europe and Korea, contribute directly to deterrence in those vital regions, as do forces participating in peacetime engagement activities. But it is the Army's full-spectrum, power-projection capability that provides a credible deterrent against potential aggressors anywhere in the world.

This power-projection capability is perhaps the greatest indicator of the extent to which the Army has changed to meet demands of the post-Cold War era. The Army has invested heavily in making its forces more strategically mobile and has improved its "fort-to-port" infrastructure significantly. The nation's strategic mobility assets, both fast sealift ships and transport aircraft, have been upgraded, and prepositioned sets of equipment reduce the time needed to put capable forces on the ground.

A vivid demonstration of our nation's enhanced ability to quickly project credible power over extended distances occurred in September 1996, when Saddam Hussein again made threatening gestures toward Kuwait. Less than 120 hours after the president approved deployment of an armored brigade from Fort Hood, Texas, the 5,000-soldier brigade was in position in Kuwait equipped with a complete set of combat vehicles drawn from prepositioned stocks. The unit was ready to conduct combat operations if necessary.

The Army ultimately will have eight brigade sets of heavy equipment prepositioned afloat or ashore in critical locations around the world. The continuing purchase of C-17 strategic transport aircraft and fast, modern sealift ships configured to carry heavy Army equipment ensures that potential adversaries will have to reckon with our ability to quickly project decisive ground combat capability anywhere in the world. This unmatched crisis-response capability will reassure our alliance partners and give pause to those who contemplate threatening important U.S. national interests.

The presence of Army soldiers also contributes directly to conflict prevention. The Army has provided a 600-soldier contingent to the multinational peacekeeping force in the Sinai for more than 14 years. In September 1994, more than 18,000 U.S. soldiers deployed to Haiti to restore the duly elected government and to prevent violence. For the past five years, more than 500 U.S. soldiers have been deployed to Macedonia to prevent the spread of conflict in the Balkans. More than 20,000 soldiers were deployed to Bosnia at the peak of implementation of the Dayton Peace Accords. Today there is a 60-soldier contingent deployed along the border between Ecuador and Peru to prevent that dispute from erupting into violence.

The fundamental purpose of the Army is to fight and win our nation's wars as part of the joint team. The National Military Strategy requires the armed forces to be able to fight two nearly simultaneous major theater wars. To meet that requirement, the Army maintains a mix of heavy, light, and special-operations forces, which allows it to apply decisive force across the entire range of military operations. The combination of quality soldiers, innovative doctrine, realistic training, and modern equipment produces a land force without equal—a strategic force capable of imposing its will on an adversary with minimum casualties on both sides. The results of Operation Just Cause in Panama and Operation Desert Storm in the Persian Gulf provide ample evidence of the Army's ability to deliver decisive victories.

This ability did not just happen. It is sustained by the training experiences that soldiers receive at the Army's combat training centers. These world-class facilities provide an instrumented battlefield that teaches commanders at every level how to operate in the most strenuous battlefield conditions and how to orchestrate the varied components of a modern military force. The National Training Center in California and the Combat Maneuver Training Center in Germany are the world's premier training facilities for mechanized forces. Light forces train at the Joint Readiness Training Center in Louisiana, where the Army also conducts peacekeeping training exercises. During those exercises, Army units interact with representatives of multinational and nongovernmental organizations they will operate with in actual peacekeeping missions.

Preparing for the Future

The Army is not resting on its laurels. It is preparing for an uncertain future by designing and testing tomorrow's Army today. This past spring the Army conducted a major warfighting experiment at the National Training Center. In this experiment, new organizational structures and the effect that modern communications and information-processing capabilities will have on future military operations were tested. Lessons learned from this experiment will provide the basis for doctrinal innovation, organizational restructuring, and insertion of new information-dominance capabilities in already-existing weapons platforms. The Army's goal is to retain its operational overmatch capabilities against any potential opponent.

The environment of the past eight years has been one of almost constant change. The world has changed, American military strategy has changed, the requirements that must be met to imple-

	Army	Navy	Marines	Air Force
Personnel reductions: **Active** **Reserve Components** **Civilian**	 15,000 45,000 33,700	 18,000 4,100 8,400	 1,800 4,200 400	 26,900 700 18,300
Major units remaining	Combat Divisions: 10 Active 8 Reserve	Carrier Battle groups: 11 Active 1 Reserve	Marine Expeditionary Forces: 2 Active 1 Reserve	Fighter Wing equivalents: 12+ Active 8 Reserve
Force structure changes	Accelerate CS/CSS conversions and Force XXI modernization	Reduce surface combatants 131 → 116 Reduce attack submarines 52 → 50 Accelerate Joint Strike Fighter (JSF)	Accelerate V-22	
Major procurement buys	Slow Theater High Altitude Air Defense System by 2 years	Reduce F/A 18 E/F 1,000 → 548 Increase JSF 300 → 480	Reduce JSF 642 → 609	Reduce F-22 438 → 339 Reduce JSF 2,036 → 1,736

Figure 2. How the services fared in the QDR.

ment the strategy have changed, and the Army has changed.

What has not changed is the need for America's armed forces to be ready to carry out the range of missions assigned to them. In the past eight years, the Army has conducted operations ranging from theater-level war in the Persian Gulf to humanitarian relief operations in Rwanda. Army soldiers have carried out the nation's bidding in countries such as Panama, Somalia, Haiti, Bosnia, and Macedonia, while the 2d Infantry Division in Korea continues the vigil begun in 1950 to bring peace to that divided land. Soldiers of Russia, Poland, the Czech Republic, Hungary, Slovenia, Ukraine, and dozens of other countries have learned about democracy from their American counterparts. People around the world recognize the American soldier as a symbol of freedom and respect for human rights.

In the end, the commitment of American soldiers is the ultimate expression of national resolve. Today that resolve manifests itself in many dimensions as our nation attempts to shape the environment of the 21st century. Whatever the task, the essential instrument of influence remains that most modern of capabilities—boots on the ground.

QDR Results

Although conventional wisdom going into the QDR dictated that the Army would suffer draconian force-structure reductions coming out of the QDR (anywhere from two to four combat divisions), such cuts never materialized. The potent argument, backed by eight years of post-Cold War data, resonated favorably in the Pentagon, on Capitol Hill, and within the national security community. As a result, the Army was able to retain its full spectrum combat capability of 10 fully resourced divisions. And, while the Army took the largest aggregate force-structure cuts (15,000 Active and 45,000 Reserve Component forces and 34,000 civilians), the Active Component cuts matched force structure with end strength, and the Reserve Component reductions eliminated force structure excess to commander-in-chief war plans. Most significantly, the QDR recognized the importance of the Army's Force XXI initiatives and modernization plan and allowed the Army to maintain the momentum of its readiness posture and initiatives. Contrast this with the significant reductions in surface combatant ships, F/A18E/Fs, F-22s, and Joint Strike Fighters (JSFs) shown in Figure 2.

So how does this affect engineers? Well, it is not entirely clear how it affects anyone yet. The QDR cuts are still being apportioned among the major Army commands (MACOMS), and the distribution of Reserve Component cuts between the U.S. Army Reserve and the Army National Guard have not been completely resolved. Once this apportionment is completed, the MACOMs will mete reductions internally. However, based on the proportion of engineers in the Reserve Components and the significant number of personnel cuts there, it seems that the Army Reserve and National Guard engineers will suffer their share of reductions.

What is clear is that engineers will continue to play a significant role in the engagement mission—the "shape" tenet of our National Military Strategy. Missions like clearing mines during Operations Joint Endeavor and Joint Guard, road building in Central America, and engineer training with our allies on the Pacific Rim will continue at least at their current pace.

As the United States increases its commitment to humanitarian demining, we can expect Army engineers to provide both expertise and manpower to this mission. Fort Leonard Wood may well form partnerships with the non-

Crossing the Sava River in Bosnia. Engineers will continue to provide mobility support to the U.S. Army into the 21st century.

governmental organizations active in the anti-landmine crusade.

Given the recent initiative to form two Active Component/National Guard integrated divisions, it is possible that Army engineers will also form composite Active/Reserve Component units. Furthermore, as many tout the efficiencies and increased effectiveness of permanent joint units, joint Army-Navy-Marine-Air Force engineer units may be on the horizon.

Finally, as the U.S. government constructs its plans to combat domestic terrorism and weapons of mass destruction, opportunities for engineers—especially in the Reserve Components—likely will increase.

The U.S. Congress will have a large say in what QDR recommendations are implemented and how they are accomplished. Congress legislates the Army's end strength and, therefore, ultimately controls personnel reductions. Additionally, subsequent to the QDR, the National Defense Panel (an independent, congressionally appointed body of civilian and retired military defense experts) reported its assessment of the QDR to Congress. Largely supportive of the QDR report and the importance of maintaining a robust land power capability (Army and Marines), the report also stresses the importance of the Reserve Components in nuclear, biological, and chemical defense and domestic terrorism. How this report alters Congress' view of the QDR and affects proposed actions, especially Reserve Component reductions, remains to be seen.

Conclusion

The impact of the Quadrennial Defense Review is still not fully evident. Other factors, to include National Defense Panel recommendations and internal Army initiatives such as Force XXI and Army After Next, will also affect the "look" of the 21st century Army. The U.S. Congress will use the power of the purse (appropriations) and its constitutional mandate to "make rules for the government and regulation of land and naval forces" (authorizations) to influence this process of change.

Our challenge is to analyze this future environment and propose how engineers will contribute to the 21st century Army. We must open vigorous dialogue and debate on how engineers can best "shape" the geostrategic environment; our role in demining operations; the organization, roles, and missions of composite and joint engineer tactical units; and our role in the defense against domestic terrorism and weapons of mass destruction. We look forward to seeing this discussion unfold in future issues of Engineer Professional Bulletin.

Major General Scott is the Chief of Legislative Liaison, HQDA. He previously served as Deputy Director of Strategy, Plans and Policy, ODCSOPS, HQDA, where he directed the Army's QDR efforts. MG Scott commanded the South Pacific Division, USACE, and both the Engineer Brigade and the 16th Engineer Battalion, 1st Armored Division. He is a graduate of the U.S. Military Academy.

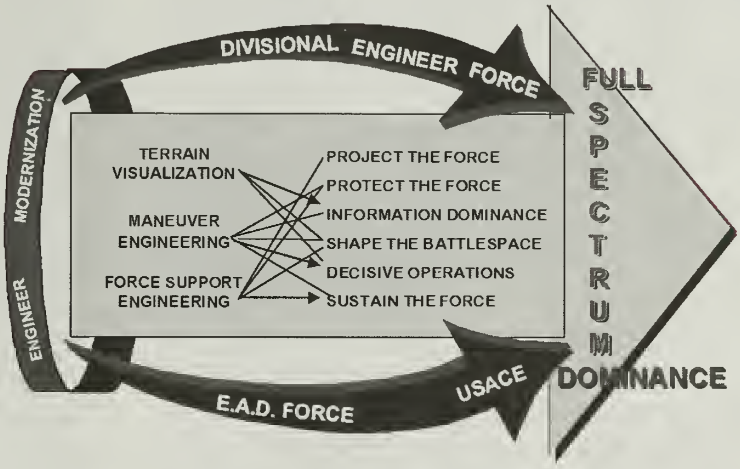
Lieutenant Colonel Gapinski is the Assistant Executive Officer, Office of the Chief of Legislative Liaison, HQDA. He has served in the 9th Infantry Division and the 1st Armored Division and will assume command of the 82d Engineer Battalion in July 1998.

ENGINEER VISION 2010

By Major General Robert B. Flowers and Michael L. Fowler

Engineer Vision 2010 is the blueprint for the engineers' contributions to the operational concepts identified in *Army Vision 2010.* It is the conceptual template to show how Army engineers will channel their vitality and innovations and leverage technological opportunities to achieve new levels of effectiveness as an integral part of the combined arms team. *Army Vision 2010* provides a coherent view of the future and the implications for land operations expressed in terms of emerging operational concepts. *Engineer Vision 2010* focuses on the implications of that environment for the fundamental capabilities and contributions of engineers toward the successful conduct of land operations—**the ability to provide prompt and sustained engineer support to operations on land throughout the entire spectrum of crisis.** *Engineer Vision 2010* identifies the operational imperatives and enabling technologies needed for the engineer force to support the rest of the Army as it fulfills its role in achieving full-spectrum dominance.

FORCE XXI PATTERN OF OPERATION
ENGINEER ENABLERS



The Vision

United States Army Engineers

- Trained and ready
- A responsive and versatile member of the strategic force
- Exploiting information technologies with effective physical and technical capabilities to master terrain, support the nation, and achieve decisive victory

In the 21st century, through maneuver engineering, engineers will employ obstacles and modify terrain to support maneuver operations and shape the battlespace. As members of the combined arms team, engineers will combine their skills with technologically advanced, information-based systems to give maneuver commanders the knowledge of the physical battlespace, lethality, and force protection they need for decisive victory. Engineers will provide terrain visualization tools and decision aids that offer commanders real-time, three-dimensional capabilities to walk, drive, or fly through terrain prior to and during deployment. To facilitate dominant maneuver, the engineer force will modify terrain and employ state-of-the-art obstacle systems to influence the conduct of enemy operations, facilitate the ability to concentrate friendly forces by securing selected avenues of approach, and reduce or clear natural and emplaced obstacles to ensure freedom of movement for U.S. and allied forces. Force-support engineering will be performed throughout the battlespace to provide essential contributions for sustainment and protection missions and to promote efficient, rapid, and seamless operational transitions.

Engineer primary functions are described as terrain visualization, maneuver engineering, and force-support engineering. The figure above shows how these functions integrate with the Army's pattern of operational construct.

Mission: Mastering Terrain

In the 21st century, engineers will employ enhanced battle command, rapidly disseminated digital information, and advanced equipment technologies to achieve much higher levels of productivity than are possible today. The high operating tempo (OPTEMPO) of mounted and dismounted operations conducted by widely dispersed combined-arms elements will require that engineers be as mobile, survivable, and sustainable as the forces they support. Situational awareness will enable engineers to quickly emplace obstacles in response to frequent changes in the threat or battlefield conditions. Engineers will control dynamic obstacle systems composed of intelligent munitions to allow free passage by friendly forces while depriving freedom of movement to potential enemies. Unmanned ground vehicles and teleoperated or robotics systems will enable engineers to accomplish hazardous missions without exposing soldiers to unnecessary risk, while providing tremendous increases in productivity. Engineers will predict requirements and base mission planning on simulations and analyses that employ state-of-the-art technologies. Robotics construction equipment, cruise-controlled operating aids, global positioning systems, and range-of-sensor controls will bring precision, speed, and nonstop operations to construction. Engineer headquarters will mass efforts precisely, monitor mission execution, and make changes "on the fly." These operations are key to the success of full-spectrum dominance. The expanded use of tele-engineering from CONUS support activities will provide a significant new capability.

A vital component of the future engineer force is the ability to gain and maintain information dominance. Information dominance will allow the engineer commander to rapidly and accurately assess situations and tailor engineer unit capabilities to suit the mission. Tailored units will be part of a mission-organized force that is designed to meet the maneuver commander's intent.

The principal engineer mission—mastery of terrain—is conducted at all levels of operations and in support of widely dispersed combined-arms forces that operate throughout an extended battlefield. Mastering terrain involves three primary functions: terrain visualization, maneuver engineering, and force-support engineering. These functions support the entire force three ways. They—

- Provide commanders an understanding of the terrain.
- Enable engineers to execute operations that control the enemy's ability to move and fight freely while facilitating the ability of friendly forces to do so.
- Provide engineering support to friendly forces to maintain the tempo of our operations.

These functions enable the commander to portray the terrain; fight where he wills; move where he wills; use the terrain as a weapon; and mount, sustain, and recover from operations by creating and maintaining an array of lines of communication (LOC). The LOC include combat trails, main supply routes, strategic entry locations, facilities, airfields, logistics bases, etc. The primary functions also encompass engineer support in defensive and combat service support areas. The requirement remains for engineers to fight as infantry whenever and wherever necessary.

Terrain Visualization. Engineer analyses of integrated joint, allied, and commercial data allow the commander to understand and "see" all dimensions of the battlespace before and during operations. By converting terrain images and other information to digital terrain data, engineers provide terrain information that relates information and data generated by every other Army battle command system to the operational environment. Engineers provide the allied forces' battle command staff with detailed knowledge of the battlespace and the precise terrain data needed to make informed battle-command decisions. By providing a terrain picture, detailed analyses of the terrain, and updating video-mapped images in real time, engineers give our forces the information they need to operate. By forecasting terrain changes over time, the commander can adjust and preplan engineer support for changes in the battlespace due to time, weather, degrading resources, etc. Digital terrain data and analysis tools underpin all information technologies friendly forces use to depict the battlefield.

Maneuver Engineering. The engineer force modifies, overcomes, and uses terrain so the commander can set the conditions for battle and achieve decisive victory while minimizing friendly casualties. This engineer support allows the maneuver commander to focus on tactical operations with advice on the best use of terrain, which allows him to set the stage for precise maneuver. Force XXI units will rely on their mobility and firepower to quickly overcome the enemy. Mobility is a key concern for the maneuver commander, and his ability to decide where and when to move must be unrestricted. The engineer force ensures this capability by building and maintaining lodgments in any environment; by finding, fixing, and building routes through any terrain; by eliminating obstacles that may impede maneuverability; and by breaching entryways into defensive structures in a MOUT (military operations in urban terrain) environment.

By using terrain as a weapon, the commander can precisely locate target sets for direct and indirect fires. By employing obstacles before and during battle and leveraging the natural, restrictive effects of terrain, engineers cause anxiety, fear, and confusion for the enemy. Obstacles affect the enemy's ability to operate and disrupt his operations and momentum, thus providing opportunities for friendly forces.

Force-Support Engineering. Throughout all phases of operations, engineers construct and augment initial defenses with fortifications and protective structures; hide the force through wide-area camouflage; and decoy enemy fires, harden critical facilities, and install sensor systems for facility protection. This support provides full-dimensional protection from enemy fire, weather, the environment, and physical limitations. Managing terrain, upgrading terrain, and construction yield friendly forces the capability to reinforce, support, maintain, supply, and reconstitute the force. Modern combat systems and new technologies (such as information-based construction techniques and lightweight, high-strength construction materials) enable engineers to provide more responsive and complete force protection.

Throughout combat operations, forces require protective positions. These positions are for soldiers, armor/mechanized vehicles, artillery, aircraft, and other equipment. Engineer soldiers provide the expertise and equipment needed to adequately protect the force in areas where they may be subject to enemy fire. In addition to building protective positions, engineers use camouflage and concealment to increase force survivability.

As operations continue, the force requires areas to conduct reconstitution operations. Engineers provide the technical expertise to plan, construct, manage, and contract, as required, adequate areas to lodge and care for soldiers.

Engineer support to the force contributes to focused logistics by creating and maintaining supply links. For the maneuver force to maintain mobility, their supply lifeline must remain open. Without adequate supply links, combat service support units are unable to deliver assets needed to keep the force moving and fighting. Engineers design, create, and maintain LOC in all areas so that traffic can move throughout the battlespace.

Engineer Leaders

In the 21st century, engineer leaders will continue to be critical advisers and planners for the maneuver commander. Engineer leaders will control teleoperated or semi-autonomous units over an expanded battlespace. They will use tools such as the Centurion (a dynamic obstacle-control system), the Maneuver Control System-Engineer, and the Route Planning and Assessment System. Engineer commanders will link with world-class experts and remote databases to enhance their ability to solve problems in the battlespace. With a solid base in engineering, combined-arms operations, information operations, and joint doctrine, engineer leaders will combine leadership skills, a deep understanding of the terrain, second-nature computer literacy, and overall versatility to provide situationally responsive support.

The Future

The road leading to Engineer 2010 will be one with many curves caused by limited resources, increased OPTEMPO, and added responsibilities. To assist in mapping our future, the U.S. Army Engineer School has chartered five new integrated concept teams (ICTs), which will develop the operational concepts for Engineer 2010. The five ICTs are: Heavy Force Engineer Operations; Light Force Engineer Operations; Theater Support Engineer Operations; Terrain Visualization; and Engineer Command, Control, Communication, Computers, and Intelligence (C4I). The ICTs are described on page 10. The Engineer School will distribute the information and plans developed by these ICTs via the school's homepage on the Internet. We request that you take time to review this information and provide us your comments and suggestions. With your help, the engineer force will continue to be a responsive and versatile member of our nation's strategic military team.

Major General Flowers has served as Commandant of the U.S. Army Engineer School and Fort Leonard Wood since July 1997.

Michael Fowler is a military engineering development analyst in the Directorate of Combat Developments, U.S. Army Engineer School.

The Road to a Regimental Vision

The Engineer Regiment's vision will be a capstone document to show the value our diverse regiment adds to the total Army as we enter the 21st century. The mission to develop a Regimental Vision was initiated by LTG Joe Ballard and MG Robert Flowers on 27 February 1998. Over the next few months, a support team will develop a first draft of the vision. A list of the milestones the support team will meet during the development process follows:

Date	Task
(1998)	
March	Support team develops draft Regimental Vision.
April	Workshop conducted at ENFORCE XXI-98.
June	Support team updates draft.
July	General officers review draft and develop an implementation strategy.
October	Regimental Vision published.
(1999)	
February	General officers assess progress and revalidate vision.
April	Regimental Vision and progress report briefed at ENFORCE XXI-99.

Integrated Concept Teams

Engineers will formulate future requirements through the efforts of five integrated concept teams (ICTs). The ICTs will develop engineer operational requirements for the Army beginning in the year 2010.

Heavy Force Engineer Operations

Senior Sponsor: Colonel Don Riley
Executive Secretary: Major Charles Radke

The Heavy Force Engineer Operations ICT will develop an operational concept for heavy maneuver engineering, validate existing capabilities or develop new operational capabilities for the future engineer force to support ground-based mounted maneuver in the 21st century, and evaluate modernization requirements based on required future capabilities. The concept will be based on results of the Division Advanced Warfighting Experiment and the resulting force structure redesign (see article, p.16). The concept also will outline the capabilities required for engineers beyond 2010.

Light Force Engineer Operations

Senior Sponsor: Colonel Edwin Janasky
Executive Secretary: Michael Fowler

The Light Force Engineer Operations ICT will develop an operational concept, validate existing capabilities or develop new operational capabilities the future light engineer force will need to support light operations in the 21st century, and evaluate modernization requirements based on required future capabilities. This operational concept will address tasks required by light engineers and outline the changes required to accomplish this role.

Theater Support Engineer Operations

Senior Sponsor: Colonel Tim Daniel
Executive Secretary: Michael Fowler

Echelons above division (EAD) engineers play a vital role in augmenting the mobility, countermobility, survivability, and general engineering required by all divisional engineers. This ICT will define the missions required for EAD engineers, determine an adequate engineer structure, and develop an optimal mix of engineer units (combat heavy battalions, wheeled battalions, mechanized battalions, combat support engineer companies, and multirole bridge companies).

Terrain Visualization

Senior Sponsor: Colonel Robert Kirsch
Executive Secretary: Jeb Stewart

The Terrain Visualization Concept was approved by TRADOC in July 1996. Even though this concept is relatively new, the accelerated pace of technological improvements in digitization, information dominance, and terrain visualization capabilities requires that it be updated. This ICT will update the Terrain Visualization Concept to define the future role of terrain visualization and the future capabilities that the engineer force will require to accomplish this role.

Engineer Command, Control, Communications, Computers, and Intelligence (C4I)

Senior Sponsor: Colonel C. M. Ferguson Jr.
Executive Secretary: Major Charles Radke

Every mission that engineers are called to accomplish includes C4I. Engineer C4I must be part of the overall Army C4I architecture. The engineer C4I ICT will validate engineer C4I requirements, ensure their compatibility with the Army's C4I plan, and develop a total, integrated modernization strategy for engineer C4I that includes requirements for topographic digital terrain data.

THE MANEUVER SUPPORT CENTER OPERATIONAL CONCEPT

By Colonel Philip Federle

The Secretary of Defense announced his recommendations to the Base Realignment and Closure Commission on 3 March 1995. Among those recommendations was one to move the Military Police and Chemical Schools from Fort McClellan, Alabama, to Fort Leonard Wood, Missouri. In a video teleconference involving Fort Leonard Wood and Fort McClellan personnel on 27 March 1995, the TRADOC commander gave his early guidance toward developing the Maneuver Support Center (MANSCEN). In subsequent briefings, his guidance was expanded as shown in Figure 1.

CG TRADOC Guidance

Intent

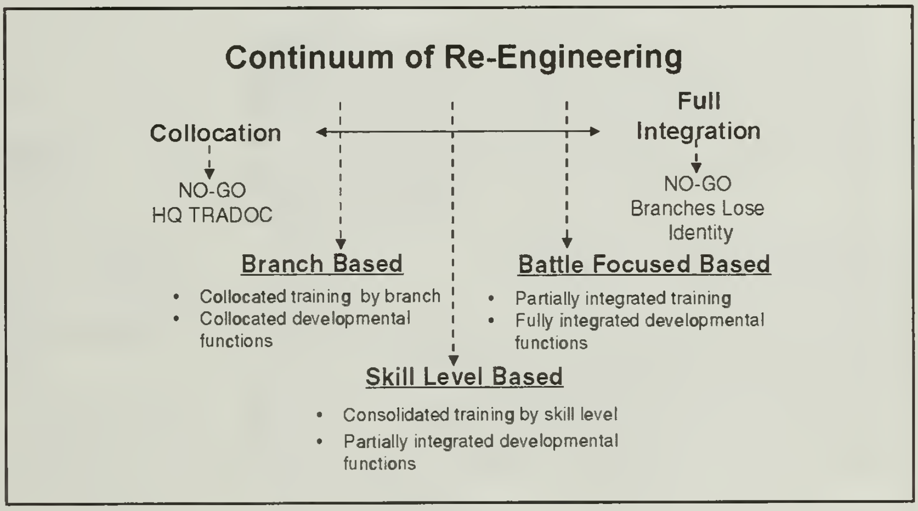
In the midterm (1997-2000), we will reorganize TRADOC into Clusters--Centers and Satellites, organized around enduring battlefield functions

Early
- Leverage the synergistic impact of the three schools.
- Consolidation is right approach.
- Must be driven by common sense; quality of training, writing, developing, and safety.

Recent
- FLW will have a Battle Lab and basic training.
- Help make MANSCEN a showcase of consolidation
- I am inclined toward SMEs, instructors, and equipment, all the execution folks, down in the training brigades.
- Each branch have a proponency office and a small group of doctrinaires.
- FLW is a manifestation of what TRADOC should be.

Figure 1

A primary concern while developing the MANSCEN operational concept was to maintain a strong proponency for each branch across the doctrine, training, leader development, organization, materiel, and soldiers (DTLOMS) program. Figure 2 depicts the relationship between proponency and the amount of integration to be achieved in building the concept.



Continuum of Re-Engineering

Collocation → NO-GO HQ TRADOC

Full Integration → NO-GO Branches Lose Identity

Branch Based
- Collocated training by branch
- Collocated developmental functions

Battle Focused Based
- Partially integrated training
- Fully integrated developmental functions

Skill Level Based
- Consolidated training by skill level
- Partially integrated developmental functions

Figure 2

During the briefing to the TRADOC commander, the consensus among the three school commandants was that with consolidated Directorates of Training Development (DOTD) and Combat Developments (DCD), we had achieved a mark about one-third of the way between "collocation" and "full integration." Since that time, the three schools have worked to consolidate common portions of the officer training courses. The commandants now agree that we have passed the midpoint along the continuum.

The operational concept was first published by the Garrison Command in June 1995. The Engineer School Directorate of Training revised it in November 1996 and again in November 1997. The revisions were the result of many discussions by key civilian and military leaders in the three schools, guided by a MANSCEN Council of Colonels. The council provided the focus to build a team among our three branches. The result is an organizational structure that will use our limited resources most efficiently. The operational concept guides facility design, development of organization mission and functions, and the tables of distribution and allowances needed to support the organizational structures agreed on by the commandants.

The road to MANSCEN is entering its final phases. Facilities are under construction and new organizations are developing operating procedures. The following article highlights how the Engineer School will fit and operate within the context of the Maneuver Support Center.

Colonel Federle is the Director of Training at the U.S. Army Engineer School. He was previously commander of the Division Engineer Brigade, 4th Infantry Division (Mech), Fort Carson, Colorado.

BUILDING THE MANEUVER SUPPORT CENTER

By Lou Holtz

The 7th of June 1997 was a great day at Fort Leonard Wood. The TRADOC commander—along with federal, state, and local civilian dignitaries and the military leadership from Forts McClellan and Leonard Wood—gathered together to turn a piece of soil and commemorate the beginning of construction for the Maneuver Support Center (MANSCEN).

Beginning in 1999, the MANSCEN commander will provide command and control for the three schools and Fort Leonard Wood. The school commandants will continue to have direct responsibility and control over their branch-specific DTLOMS functions. However, MANSCEN will consolidate most nonteaching functions of the three schools, provide consolidated officer and noncommissioned officer (NCO) education systems, and horizontally integrate other school activities. The schools will conduct branch-specific and one-station unit training (OSUT) within their branch brigades. Activities of the Maneuver Support Battle Lab and the three consolidated directorates will be guided by a Board of Directors chaired by the MANSCEN commander, with the three commandants as voting members.

Several articles in recent issues of *Engineer* described development of the MANSCEN. An article in the April 1996 issue introduced the MANSCEN concept and movement of the Military Police and Chemical Schools to Fort Leonard Wood. The December 1996 issue included an article on construction that would take place during the next two years. The new MANSCEN Battle Lab was described in an article published in April 1997.

This article explains how the Engineer School will fit into and operate within the MANSCEN structure (Figure 1).

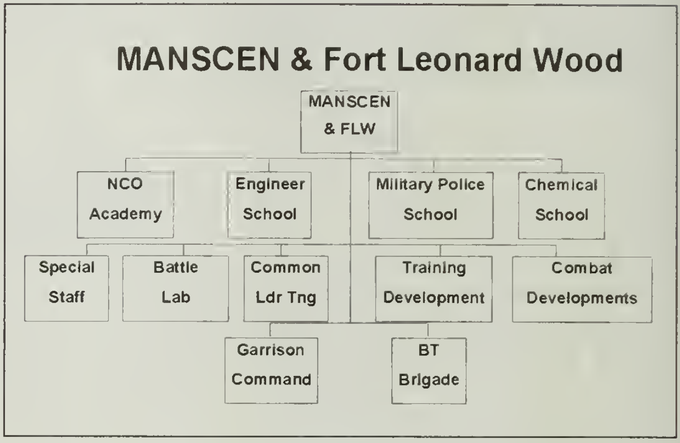


Figure 1

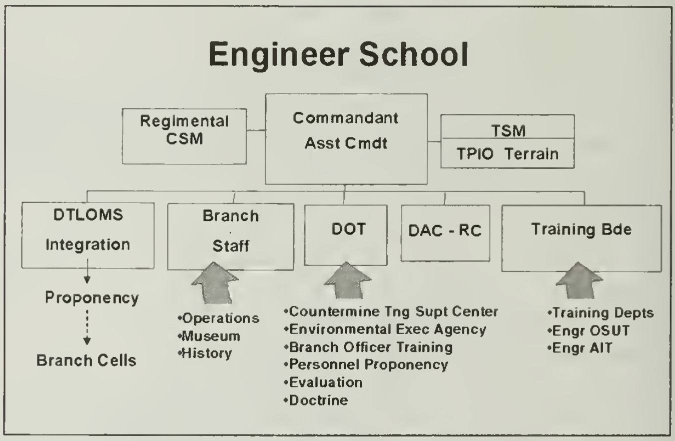


Figure 2

Engineer School Structure

The Engineer School's organizational structure within the MANSCEN is shown in Figure 2 and described below.

The *DTLOMS Integration Office* is the one new organization developed during MANSCEN planning. It will provide commandants a direct link with the three consolidated, school-related directorates.

The *Branch Staff* will support the commandant. Although the museum staff is listed on the chart, their workplace will be in the museum complex with museum staff from the other two schools.

Two *Deputies Assistant Commandant* (U.S. Army Reserve and Army National Guard) *for Reserve Components* (DAC-RC) will be in the Engineer School to oversee total force integration. They will ensure that Reserve and National

Guard needs are addressed by the schools and the MANSCEN.

The *Director of Training* (DOT) will plan training strategy, guide the school in Army Training XXI initiatives, lead the doctrine development effort, and serve as course director (Figure 3). The DOT also will be responsible for branch-specific functional and officer training not assigned to the school training brigade. The DOT will serve as the focal point to ensure that the commandant's intent for engineer training is carried out by the *Directorates of Training Development and Common Leader Training* (DCLT).

The *Countermine Training Support Center* will continue its present mission to train military, governmental, international, and nongovernmental agencies on countermine and demining subjects. It will also produce mine-recognition products to be used as training aids both for deploying units and for "train the trainer" programs aimed at helping other countries in demining efforts.

The *Doctrine Staff* will plan and execute the Engineer School's doctrine-writing program. They will coordinate the review of proponent and nonproponent doctrine with subject matter experts (SMEs) in the school and in the field. The staff will serve as liaison to the Combat Training Centers, Combined Arms Center, and the joint doctrine community throughout TRADOC.

The *Engineer Personnel Proponency Office* (EPPO) will advise and assist the Engineer School commandant to establish military personnel management policies that produce technical and tactical soldiers for the total force. The director will coordinate with Department of Army and TRADOC staff to ensure that engineer officer, warrant officer, and enlisted personnel needs are met. The director also will develop and review qualification standards for soldiers at all levels.

The *Training Evaluation Office* will be a partial return of the disbanded "Directorate of Evaluation and Standardization" function. Training Evaluation personnel will conduct selected internal and external evaluations of training, training products, doctrine, materiel, and training development processes. They will focus on both Active and Reserve Component training and will conduct the certification program for Total Army School System battalions.

The engineer portion of the officer basic and advanced courses and the warrant officer courses will be managed within the *Officer Training Department.* This department will also provide SMEs to support doctrine writing and review as well as external taskings.

The Engineer School will serve as the Army's *Environment Executive Agency* to develop and integrate environmental doctrine and training products applicable to soldiers and units. The office will conduct that mission under the guidance of the DOT. It also will support the production of courseware and other training products for use in the Total Army School System.

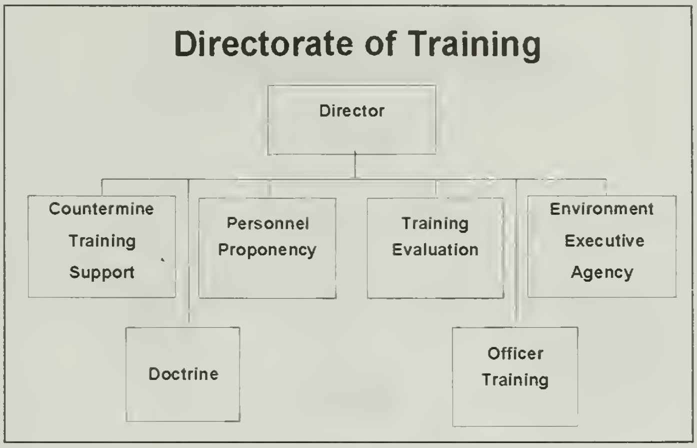


Figure 3

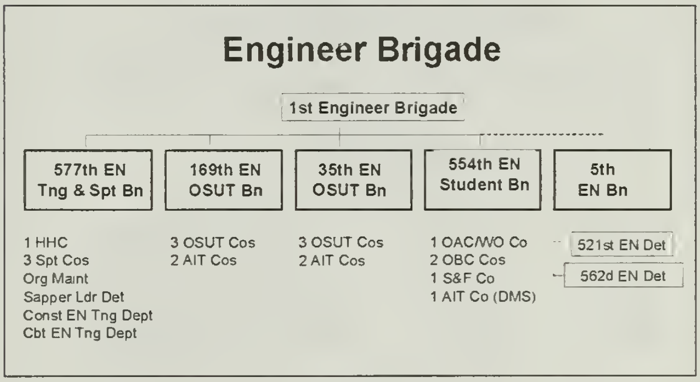


Figure 4

Each school will have a branch-specific training brigade as shown in Figure 4. The *1st Engineer Brigade* will be similar in structure to what we have today except that the 58th Transportation Battalion will move to the Chemical Brigade. The mission of the engineer brigade will be to train soldiers, sailors, airmen, marines, leaders, and units; support training; and be prepared to support contingencies and emergency response operations.

The *577th Engineer Training and Support Battalion* will train service members and leaders and support assigned MANSCEN training. This battalion will contain both the *Departments of Combat Engineering and Construction Engineering,* where students will learn engineer Advanced Individual Training (AIT) skills.

Both the *169th* and the *35th Engineer Battalions* will conduct Combat Engineer and Bridge Crewman OSUT for initial entry soldiers, preparing them for assignments to the total Army force. They will also provide premobilization training for Reserve Component cadre.

The *554th Engineer Student Battalion* will train engineer officers and international military students attending Engineer

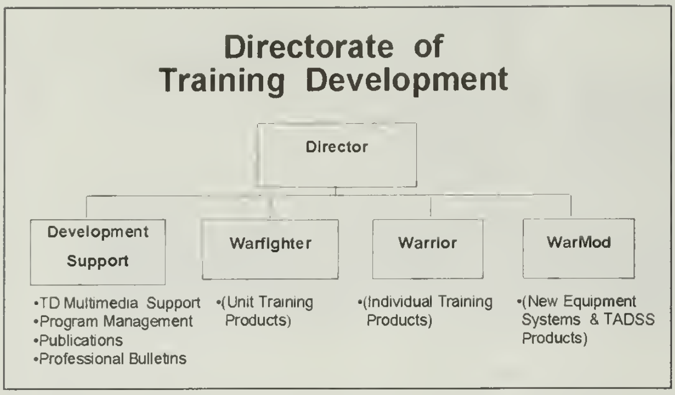

Directorate of Training Development
Director
Development Support
Warfighter
Warrior
WarMod
•TD Multimedia Support
•Program Management
•Publications
•Professional Bulletins
•(Unit Training Products)
•(Individual Training Products)
•(New Equipment Systems & TADSS Products)

Figure 5

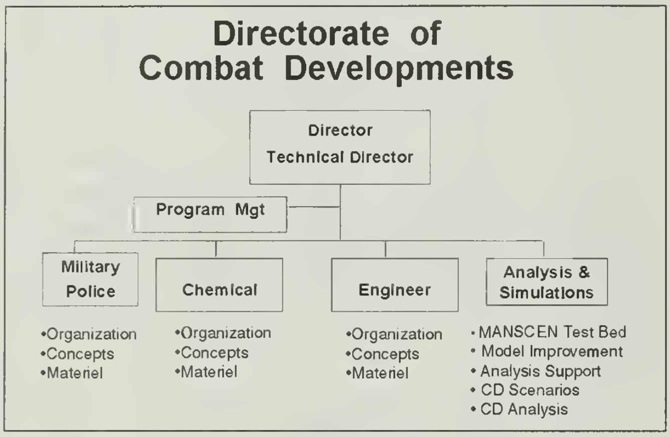


Figure 6

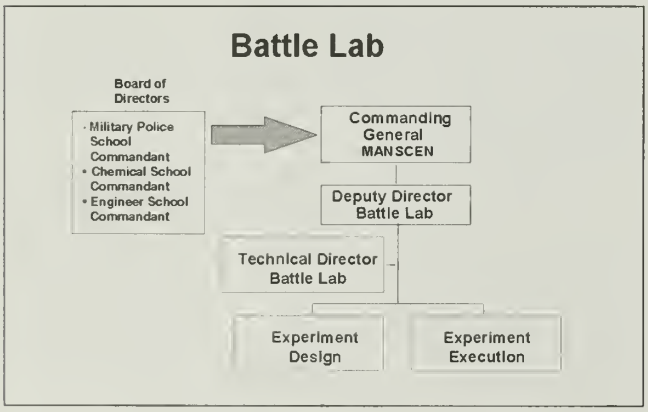

Battle Lab
Board of Directors
· Military Police School Commandant
• Chemical School Commandant
• Engineer School Commandant
Commanding General MANSCEN
Deputy Director Battle Lab
Technical Director Battle Lab
Experiment Design
Experiment Execution

Figure 7

School courses to provide warrior leadership to the total Army force.

MANSCEN Directorates

The school-related MANSCEN directorates provide missions and functions for all three schools (see Figure 1). The *DTLOMS Integration Office* in each of the schools maintains coordination with these organizations to supplement guidance provided by the board of directors. Each school commandant also will serve as a deputy commanding general with an assigned responsibility to either common training, training development, or combat development. In this capacity, each commandant will monitor the organization's activities and report to the board of directors.

Directorate of Training Development

The *Directorate of Training Development* (Figure 5) will be responsible for the horizontal integration of training development activities for the three schools. Four departments will address the full spectrum of training development and the Army Doctrine and Training Literature Program (ADTLP) production.

The *Development Support Department* will provide general training development support. It will manage the command's participation in the ADTLP and publish all training and doctrinal materials developed by the command. It also will publish three separate branch bulletins.

The other three departments will have branch-specific cells that are responsible for fulfilling branch functions in their respective areas. The chief of each branch-specific cell will be senior rated as designated by their school commandant.

The *Warfighter Department* will perform collective analysis, develop Army Training and Evaluation Program Mission Training Plans and Battle Drills, and write warfighter Training Support Packages.

The *Warrior Department* will perform individual, front-end analysis; design and develop soldier training products; and develop programs of instruction, to include resident and distributed training products and Total Army Training System courseware.

The *Warfighter Modernization (WarMod) Department* will design and develop training for new equipment systems. It also will develop and integrate requirements for training aids, devices, simulations, and simulators (TADSS).

Directorate of Combat Developments

The *Directorate of Combat Developments* (Figure 6) will provide horizontal integration of combat development activities for the three schools. Three branch-specific divisions will be responsible for branch-specific functions. The chief of each branch-specific division will be senior rated as designated by their school commandant.

The *Program Management Office* will be responsible for overall administration and resource support.

The *Analysis and Simulations Division* will provide staff supervision of modeling, analysis, and simulations in support of chemical, engineer, and military police developmental processes. It will provide branch-specific input to the modeling and analysis community.

Maneuver Support Battle Lab

The *Battle Lab* (Figure 7) will plan and conduct warfighting experiments related to maneuver support. It will provide an institutional process for gaining insights from progressive and iterative high-fidelity constructive, virtual, and live experiments using soldiers and units in relevant, tactically competitive scenarios. It also will examine emerging DTLOMS programs.

The MANSCEN commander will serves as director of the Battle Lab. The board of directors will provide overall guidance, but the deputy director (a colonel) will provide daily supervision. The staff will include engineer, military police, and chemical officers, NCOs, and civilians, as well as combat arms personnel.

Directorate of Common Leader Training

The *Directorate of Common Leader Training* (Figure 8) will be unique within the TRADOC community because it will conduct all officer core training. (Each school will provide branch-unique officer training.) Much effort and teamwork among the three schools were required to take the officer training courses apart, pull out common portions, and then reassemble them. Course start dates were aligned so that one department can teach all common portions. This structure provides the best opportunity for us to share training among the three branches and with NCO students. It also allows us the opportunity to explore synergism among the three branches through training exercises. The MANSCEN DOTD will maintain the program of instruction.

Within the structure, the *Combined Arms and the Combat Support/Combat Service Support Divisions* will provide instructors for the various course subjects.

The *Instructional Support Division* will operate and maintain special training support facilities. A single academic library will be operated for all three branches. This division also will be responsible for all-service resident instructor training and certification.

NCO Academy

The *NCO Academy* will be the largest in TRADOC to teach solely at the Basic NCO Course/Advanced NCO Course (BNCOC/ANCOC) levels (Figure 9). It will be led by a commandant who is a command sergeant major. *Administration, Supply, and Operations Offices* will provide support to the MANSCEN directorates. All training will be conducted using small-group-leader methodology, as required by the Sergeants Major Academy. The MANSCEN DOTD will develop branch-specific portions of these courses according to the training strategy and policy guidance of each branch commandant.

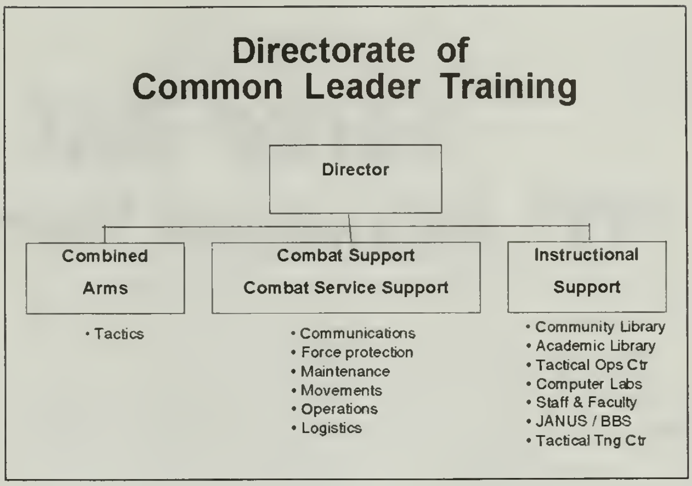


Figure 8

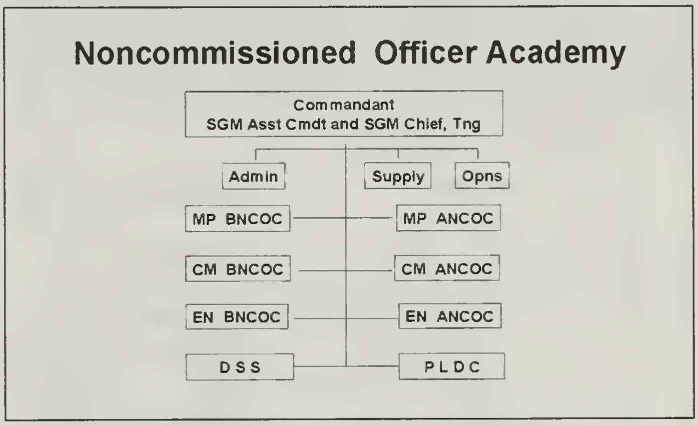

Noncommissioned Officer Academy
Commandant SGM Asst Cmdt and SGM Chief, Tng
Admin
Supply
Opns
MP BNCOC
MP ANCOC
CM BNCOC
CM ANCOC
EN BNCOC
EN ANCOC
DSS
PLDC

Figure 9

Conclusion

The concept of operation for the MANSCEN was developed by Military Police, Chemical, and Engineer School personnel—working under the guidance of the MANSCEN Council of Colonels—with frequent azimuth checks from the school commandants. We used the concept to develop a draft mission and functions manual and an FY00 table of distribution and allowances for the three schools and the Fort Leonard Wood installation. Although the concept is not finalized, the commandants have agreed that it is time to stop working on this phase and move on to the detailed planning required to bring the three schools together. We'll know that implementation has begun when military police and chemical trainers and combat developers begin to arrive at the Maneuver Support Center about this time next year.

Mr. Holtz is the technical director for the Directorate of Training. He has served as deputy director of the Directorate of Training and Doctrine Development and helped plan and execute the move of the Engineer School from Fort Belvoir in 1987-88. Mr. Holtz holds a master's degree in education and has completed postgraduate work in administration.

Force XXI Engineers:
1997 Advanced Warfighting Experiments

By Vern Lowrey and Major Douglas Victor

Since 1994, the U.S. Army Engineer School has been developing engineer contributions for Force XXI, a process that will lead to Army XXI by the year 2010. Army XXI, a term similar to *Army of Excellence,* is the Army's effort to advance into the 21st century with the most capable land combat force in the world. Undoubtedly there will be changes in the way Force XXI forces conduct combat operations because of—

- Information-age capabilities.
- Increased integration of service components into an effective combat team.
- More lethal, survivable, and agile systems.
- More capable soldiers and leaders.

Force XXI Operations

Force XXI operations will have six characteristics:

Multidimensional. Force XXI forces will operate in an expanded battlespace that goes beyond traditional physical dimensions for width, depth, and height. Through communications and digital connectivity, Army, joint, and coalition elements will operate beyond traditional boundaries and reach back to the continental United States.

Precise. Precision is fostered by three emerging capabilities: digitization, sensors, and simulations. Digitization provides soldiers and leaders at each echelon the information required for making sound decisions. A full suite of sensors linked to analytical teams will fuse combat information into situational awareness. Simulations will enable commanders to tailor and rehearse Army elements, which will yield precision in execution.

Nonlinear. Nonlinear operations are fluid. They change as mission, enemy, troops, terrain, time available, and civilian considerations (METT-TC) change through the duration of mission preparation and execution. Force XXI forces must have greater situational awareness because of this dynamic environment.

Distributed. Operations are distributed and dispersed where and when required to achieve decisive effects versus being concentrated at a possibly decisive point. Distributive operations empower subordinates to operate independently within the commander's intent, leading to synergistic effects that exceed the effects of a centralized headquarters.

Simultaneous. Simultaneous operations seize the initiative and present enemy leaders with multiple crises and no effective responses. Lethal and nonlethal attacks are executed as simultaneously as possible.

Integrated. Integration enables the Army to leverage the full suite of capabilities that joint, multinational, and nongovernmental partners bring to the fight.

Force XXI operations will be executed through deliberate patterns that incorporate all elements of operations from initial receipt of mission through return to home station. The patterns are not phases, nor are they sequential. They focus the many tasks armies have always performed in war and other military operations. Made possible by technology, these patterns—

- Project the force.
- Protect the force.
- Gain information dominance.
- Shape the battlespace.
- Conduct decisive operations.
- Sustain and transition the force.

Advanced Warfighting Experiments

Two Force XXI Advanced Warfighting Experiments (AWEs) conducted in 1997 provided numerous insights and decisions toward fielding the first digital division by the year 2000. The Task Force XXI AWE at the National Training Center at Fort Irwin, California, in March 1997, was followed by the Division XXI AWE at Fort Hood, Texas, in November 1997. An article on page 19 describes the Fort Hood AWE.

TRADOC Insights

The following TRADOC insights were gleaned from the 1997 AWEs:

Doctrine

Due to Force XXI experimentation, doctrine must now support the analog, digital, and composite forces of the total Army. The following doctrinal changes are driving other DTLOMS (doctrine, training, leader development, organization, materiel, and soldiers) areas:

- ☐ Information operations are becoming a combat multiplier.
- ☐ Deep fires using aviation and rocket artillery are becoming more precise and lethal. Aviation and field artillery now routinely conduct decisive operations.
- ☐ Force protection and security challenges are increased because of nonlinear and distributed operations.
- ☐ The deliberate planning process is changing. It is no longer a plan-execute-plan process but a distributive and collaborative planning process.
- ☐ Combat service support organizations must be flexible and modular. Consequently, Force XXI must still work many of the details for the centralized logistics concept.

Training

Simulations will be invaluable to the Force XXI training strategy. By combining training management tools in our Combined Arms Training Strategy with training systems like Battle Command Staff Trainer, the Army can develop and train baseline warfighting skills for tactically competent leaders, soldiers, and combat teams. These systems will be the cornerstone for the digitized Army training strategy as we transition from a combined analog/digital to a digital corps.

Current digital command and control (C2) systems require extensive trainup and sustainment training to retain proficiency.

Distance learning is an essential ingredient to the Force XXI training strategy. Consequently, the Army must continue to provide task-based training from institutions when and where it is needed to support the total Army, including the digital force. Our capability to support distance learning is limited today, but the Army Distance Learning Program's vision and milestones will ensure success (see article on page 28)

The underlying, sequential piece for the Force XXI training strategy is the Army's continued commitment to develop competent warriors and trained units. Analog warfighting skills are prerequisites for Force XXI forces.

Leader Development

The TRADOC commander and other senior leaders agree that our biggest challenges are leader development and training. Staff functions and relations are changing and will continue to change as Force XXI matures. Leaders must be able to maintain the tempo of fast-paced operations.

We need a streamlined planning process that increases the importance of the commander's intent. Consequently, leaders must be able to operate from a sketch and a few words instead of formally written operation orders with many annexes. The ability of our leaders to develop a balance of digital and tactical maturity will be critical to the effectiveness of Force XXI.

Organizations

The TRADOC commander approved the design of the conservative heavy division (CHD). Its ability to leverage corps-allocated assets will enable it to achieve success. For Reserve Component engineers, this ability is relevant because of the division's increased dependency on echelon above division (EAD) forces. The CHD can be used as digital support for either an operational or strategic force.

Units, to include ground maneuver forces, can be smaller and more lethal when equipped with digital technology and linked with modern sensors (such as unmanned aerial vehicles, joint surveillance and target-attack radar systems, and Raptor). However, logistics support organizations cannot be significantly reduced since they remain critical for mission success.

Materiel

Force XXI is a proven success, which indicates that experimentation is clearly the right process. Force XXI required reconceptualization and redesign of the force at all echelons, including reserves, civilians, and the industrial base.

Video teleconferencing using interactive whiteboard technology is changing the nature of command and control. Now all commanders can provide guidance and direction remotely over the extended battlespace without having to link up face to face.

Soldiers

No matter how impressive digitization is, it is only a tool soldiers and leaders use to increase their capabilities.

Engineer Insights

The following engineer insights were gleaned from the 1997 AWEs:

Doctrine and Training

Heavy divisional engineers (primarily active duty) focus mainly on mobility tasks during decisive operations and place less emphasis on countermobility and survivability tasks.

Other countermobility, survivability, and general engineering support needed to shape the battlespace and to protect and sustain the force must now come from EAD engineer units (primarily Reserve Component). Augmentation of EAD engineers to the digital division will require a total Army training strategy to hone the skills of the entire division combat team.

Heavy engineer forces now operate almost exclusively from mounted platforms with limited dismounted sappers.

This transition from a sapper- to an equipment-based force increases our dependency on scatterable mine systems for tactical obstacles and on future mounted-obstacle and lane-marking systems.

Combat service support for the heavy division engineer battalion is now centralized at the brigade forward support battalion.

Topographic engineering is evolving from the development of digital terrain products and tactical decision aids (primarily paper) to terrain data management.

Leader Development

Engineer leaders require additional skills in terrain visualization and digital engineer planning and execution. Digital engineer leaders must continue to master basic combined arms warfighting skills, which are prerequisites for all digital engineer leader proficiency.

Organization

An engineer C2 headquarters is needed at the brigade combat team and division levels to orchestrate the myriad of engineer tasks required in each pattern of Force XXI operations. Integration of digitized and nondigitized engineers (primarily Reserve Component) to conduct decisive operations is difficult and requires more liaison capability and digital C2 support packages. Heavy brigade combat teams now require terrain analysis teams equipped with the Digital Topographic Support System (DTSS) because of the increasing digital terrain data management requirements.

Materiel

To maintain situational awareness and a common operating picture, engineers require the same digital C2 equipment as the force they support. Engineers also need a digital planning and execution capability resident in the Army Battle Command System (ABCS). All commanders require a full suite of high-resolution terrain data to gain information dominance and visualize the battlespace. DTSS provides the most current digital terrain picture to ABCS components.

The Grizzly will enhance Force XXI complex obstacle-breaching capabilities. However, engineers still require improved mine-detection and standardized lane-marking systems for breached minefields.

Hornet wide-area munitions have the potential to provide greatly increased lethality on the battlefield. The Raptor Intelligent Combat Outpost has tremendous potential to shape the battlespace in conjunction with other intelligence sensors and artillery and aviation deep-strike weapon systems.

Soldiers

Engineer soldiers require increased skills in the use of digital C2 equipment. As terrain analysts, engineers need a full suite of skills from terrain product development to digital terrain data management. Digital engineer soldiers must continue to master basic warfighting skills, which are prerequisites for gaining digital engineer soldier proficiency.

Future Experimentation

Through Force XXI efforts, the Army has shown the value of large-scale experimentation. TRADOC is developing an Army Experimentation Campaign Plan to build on results from Force XXI experiments. The Maneuver Support Battle Lab is working engineer, chemical, and military police issues into four experimentation axes, which the Army Chief of Staff will consider for approval in FY98:

- ❒ An EAD/Corps/Echelon Above Corps axis to continue experimentation toward fielding the first digital heavy corps by 2004.
- ❒ A Joint Contingency Force axis to provide a lighter, more lethal digital contingency force capability by 2002.
- ❒ A Strike Force axis that seeks to develop highly lethal and quickly deployable force capability by 2010.
- ❒ An Army After Next axis to address capabilities needed by the Army in 2025.

For further information on AWE and engineer issues, contact the Maneuver Support Battle Lab at (573) 563-4082 or fax—4083. The e-mail address is: dbl@wood.army.mil. The Internet address is: www.wood.army.mil/MSBL/msbl.htm.

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Major Victor is the Force XXI Project Officer for the Directorate of Training, U.S. Army Engineer School, Fort Leonard Wood. He served as an engineer subject matter expert during the Division XXI AWE at Fort Hood. MAJ Victor previously served as an engineer observer/controller at the Joint Readiness Training Center and was a tactics instructor at the Engineer School.

ENGINEERS IN THE 21ST CENTURY

By Captain Mario Perez, Lieutenant Colonel C. Kevin Williams, and Colonel E. W. Chamberlain III

When the smoke cleared and the electrons stopped flowing at the Division Advanced Warfighting Experiment (DAWE) at Fort Hood, Texas, 26 October – 15 November 1997, the free world was once again safe as the 4th Infantry Division (Mechanized) reigned victorious over the BISDON Alliance. The experiment highlighted several learning points affecting how combat engineers will be employed in the future battlespace.

The purpose of this experiment was to test the division's command and control structure and the effectiveness of several new high-technology systems. Although Force XXI places new combat systems in engineers' hands, the concept represents more than incorporating new technology into current doctrine. For success in the future battlespace, engineers must shift the way they operate. Major countermobility and mobility issues identified during the DAWE will affect how combat engineers will support mid- to high-intensity environments. This article describes how the 3rd Brigade Combat Team (BCT)—the Iron Brigade—and the 4th Engineer Battalion, 4th Infantry Division, employed future engineer systems to aid in defeating the enemy.

Countermobility Operations

The Raptor Intelligent Combat Outpost is the most dramatic example of a new high-technology system combat engineers will use to shape the future battlespace. The purpose of the Raptor is to improve the commander's ability to dominate battlespace. This is achieved by employing an unmanned and unobserved outpost that can detect, report, and engage the enemy. The Raptor is best described as a *hunter-killer* system. It consists of three advanced acoustic sensors, two gateways, a control station, and sixteen munitions—currently it employs improved Hornet munitions. Sensors and communication networks linked into the control station at the maneuver brigade tactical operations center (TOC) extend the eyes and ears of the commander to areas he cannot see or where he cannot assign combat forces to cover.

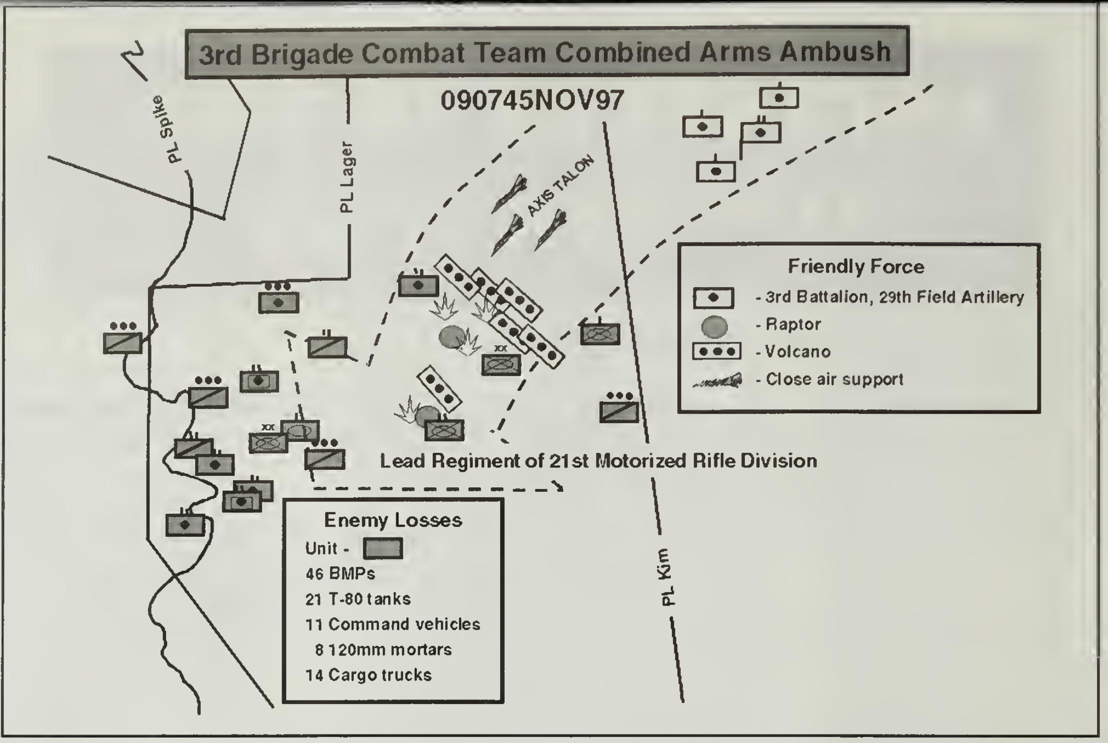
The Raptors' sensors *hunt* the enemy and pass combat and targeting information through a governing gateway to the control station in the same way that a manned observation post or forward observer passes information to the TOC. The acquired information enhances the commander's situational awareness and provides targeting information for indirect fires, attack helicopters, or close-air-support missions.

The Raptors' Hornets can also communicate with a controlling gateway and provide an on-site *killer* capability for the commander. He can employ the Raptor as a stand-alone system or in conjunction with other lethal systems. The control station can place the Hornets in either a "sense" or an "armed" mode. A Raptor in the sense mode tracks and reports activity and passes targeting information back to the TOC. An "armed" Raptor not only tracks and reports, it also attacks targets with its Hornet munitions. Because Raptor has the ability to overwatch itself, report its location and status, and provide targeting information, the need for continuously manned over-watching forces is reduced or eliminated.

The Iron Brigade employed the Raptor in three basic ways during the DAWE:

- The Raptor was employed forward in the brigade's sector to provide reconnaissance, intelligence, surveillance, and target information in targeted areas of interest (TAI). The Raptor confirmed avenues of approach used by the enemy during his attack, and we used that information to trigger artillery fires or close air support.
- The Raptor provided flank protection for the brigade. The system can be employed quickly on an avenue of approach into the brigade's flank—a platoon can emplace one kilometer of coverage in about one hour. The Raptor delayed enemy movement, and the early warning it provided allowed us to reposition combat power.
- We also employed a technique called the "Raptor Raid," which is an air-assault mission where engineers emplace Raptors deep in enemy flanks. We conducted Raptor Raids simultaneously with ground movements into the sector. After ground forces arrived in the sector, we switched the Raptor to the "sense" mode so the ground forces could immediately counterattack.

The Iron Brigade had its greatest success using the Raptor as part of a deep fight engagement area. We built the engagement area using air Volcanos at a natural TAI where several avenues of approach converged. Artillery, attack helicopters, and close air support covered the engagement area with fires. Raptors in the sensing mode triggered deep attacks as the enemy entered the engagement area. After the enemy began breaching the Volcano obstacles, the Raptors were switched to the armed mode. The combined effect of the deep



attacks and placing obstacle systems forward of the brigade's location broke up enemy formations and added to his confusion of our intent and where our combat elements were located.

The Raptor is an excellent system, but we noted some limitations during the DAWE. The simulated capabilities portrayed were based on a Raptor system that technically could be available to the division by 2003. For example, the Raptor's communication link was limited to 30 kilometers from its control station, and the components must be hand emplaced. The Maneuver Support Battle Lab at Fort Leonard Wood is experimenting with a long-distance communication link and an unmanned, deep-delivery system to fix that shortfall. Additionally, the Raptor was difficult to control across the division area because of the fluidity of the battlespace and rapidly changing brigade sectors. An engineer brigade headquarters is needed to assume overall control of the Raptors and to arbitrate which BCT will control specific Raptors. This headquarters could also control the resupply of Raptors throughout the division.

The potential elimination of conventional mines by law will significantly impact 21st century engineers and their ability to accomplish countermobility missions. During the DAWE, the division depended heavily on Hornet, Raptor, Volcano, Gator, and ADAM/RAAM munitions. Because these systems are relatively easy to employ, the Iron Brigade emplaced approximately 90 kilometers of obstacles in 30 hours. Engineers may need to re-evaluate the way both air and ground Volcanos are used and how best to control them. We currently use Volcanos mainly as situational obstacles to supplement the commander's obstacle plan. In the Force XXI environment, Volcanos may be the primary countermobility system available to engineers.

Engineer platoon leaders traditionally supervise the siting and emplacement of Volcano minefields. Assuming that the dramatic increase in Volcano use experienced during the 1997 DAWE is accurate, it will be impossible for a platoon leader to directly supervise all Volcano emplacements. This is especially true when Volcanos are used to support a maneuver element on the move by emplacing Volcano obstacles on the flanks. With the platoon leader providing mobility support, the team tasked to emplace Volcanos must travel to an obstacle site with an obstacle intent, adjust the obstacle based on the terrain, emplace an effective obstacle, and link up with the platoon on the move. To accomplish that significant feat, Volcano section and squad leaders require intensive training on the capabilities and employment of the Volcano system. Engineer leaders must follow unit standing operating procedures (SOPs) and incorporate rehearsal requirements into the brigade's defensive plan.

If conventional minefields are eliminated, engineers will depend more heavily on 48-hour duration Volcano and ADAM/RAAM minefields. The ability to rapidly affect mobility over a wide frontage of the battlespace and the lasting effects of 48-hour obstacles will force engineers to adhere strictly to obstacle-control measures. Although adherence to obstacle-control measures has always been important, it will be paramount in the high-tempo and fluid Force XXI environment. Brigade boundaries changed dramatically and often throughout the DAWE, and the brigade's area of interest was much larger than is typical today. Rapid boundary changes require engineers to maintain a greater situational awareness and may require tailoring Volcano munitions to better fit our needs. For example, we may need an 18-hour life span and an off-on-off capability for Volcanos. In any case, engineers must continually coordinate with the engineer brigade, cross-talk between engineer battalions, and strictly adhere to obstacle-control measures to maintain situational awareness in the area of interest.

Mobility Operations

Mobility operations will not change as dramatically as countermobility operations in the near future, but we noted some important improvements during the DAWE. The Wolverine provides an incremental improvement over the current armored vehicle-launched bridge (AVLB) because it has better mobility and survivability and spans a wider gap. The Grizzly provides engineers with an enhanced mechanical breaching capability and additional flexibility when allocating mobility assets throughout the brigade. During the DAWE, the engineer battalion provided mobility support to an artillery brigade moving through the maneuver brigade sector. The engineer battalion accomplished this mission by attaching a Grizzly team (instead of an engineer line platoon) to the artillery brigade. The DAWE also reinforced the requirement to place engineer assets forward in a maneuver formation. Contrary to some current thinking, technology has not diminished this requirement at all.

Formation of the multirole bridge company (MRBC) is another good mobility initiative. The MRBC consists of a traditional float bridge company plus four 40-meter spans of the new heavy dry support bridge (HDSB). The HDSB eventually will replace the medium girder bridge. Each corps is assigned three MRBCs. In the DAWE scenario, all three companies were controlled by the 4ID. The exercise was fought in a European scenario, which reinforced the requirement for bridging assets. The 4ID had about the right amount of bridging assets to maintain flexibility within the division, but it had the entire III Corps allocation of MRBCs. The division often attacked with two brigades abreast, and each required a minimum of two spans to support an assault river crossing. Engineers may require additional bridging to meet anticipated needs.

Inclusion of a terrain team at the brigade level is a great engineer initiative. The brigade terrain team consists of two noncommissioned officers, two enlisted soldiers, and the Digital Topographic Support System (DTSS). During the DAWE, the DTSS enabled the brigade engineer to generate specialized terrain products within a matter of hours. As other battlefield operating systems' representatives became aware of this new capability, mission requirements for the terrain team increased rapidly. The team generated cross-country mobility overlays, identified tentative river-crossing sites, developed three-dimensional perspectives, masked area plots, and provided various specialty maps. There was a sharp learning curve associated with integrating the team into the brigade planning process. It was compounded by the fact that a chief warrant officer is no longer the link between planners and technical experts. Engineer units must increase the training officers and NCOs receive to take full advantage of this new capability.

The terrain team is most useful when it is integrated early into the planning process. For example, as soon as an area of interest is identified, the terrain team should start preparing general products such as cross-country mobility overlays or river analyses. If a terrain team is added as a slice element during a deployment, it cannot provide this kind of support in advance of the operation. It would help to make the team organic to the engineer battalion, because this would foster a habitual relationship and allow for home-station training. Additional work is needed to develop an SOP and a standard "push package" of terrain products for subordinate task forces. Use of the brigade terrain team was a learning experience for the Iron Brigade, and its full potential has yet to be realized.

Looking Ahead

Transition to the 21st century brings many exciting changes to the way engineers conduct countermobility and mobility operations. To take full advantage of the new technologies, engineers must change their mindset. Force XXI represents more than the integration of new systems into old doctrine, but several constants will not change. When emplaced on the ground, obstacles will kill friendly as well as enemy forces. Obstacle-control measures, obstacle tracking, and situational awareness remain vital to brigade engineers. Technology has not eliminated the requirement to locate engineers forward in the maneuver formation. A thorough evaluation of the terrain is critical. Engineers will continue to be a valuable combat multiplier in the 21st century battlespace if we can retain critical lessons learned in the past and adapt current doctrine to fully exploit the technologies and ideas of the future.

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British Army 2000: The Future Army

By Colonel Phil Lilleyman MBE

In the scope of history, the perceived and well-documented threat posed by the Soviet Bloc was an aberration, as was the "layer-cake" defensive posture of NATO. The end of the Cold War returns us to military structures based on a desired capability and a desired style of fighting. This article describes the British Army's approach to the same reassessment process that is sweeping through the U.S. Army and the armies of our other major allies.

Structural Reappraisal

Work began in 1994 on "British Army 2000 (BA 2000)." This was an internal process of fundamental structural reappraisal brought about by the changing strategic environment, the pace of technological change, and the formal adoption of a maneuverist approach to operations. Wide consultation through working groups produced a Foundation Paper in 1995 that examined factors affecting future Army structures and set an agenda for subsequent work.

In 1996, another paper assessed the nature of armed conflict in the first part of the next century. This paper accepted that warfare did not lend itself to tidy classifications and did not attempt to define conflict absolutely. Instead, it developed two speculative views of conflict as a premise for further study.

View One

The first view was symmetric. It showed an extrapolation of current trends in regional conflict. The United Kingdom was an alliance or coalition partner, prosecuting a joint expeditionary campaign of high tempo and deep maneuver. This would be followed by a post-conflict period of regional support and stabilization.

View Two

This view was asymmetric. It portrayed an Army opposed by irregular forces—having few moral constraints and applying terror and coercion as a central strategy—directed by miscellaneous social entities. They would be armed with a wide variety of weapons, including limited access to weapons of mass destruction.

The Director of General Development and Doctrine was tasked to recommend adjustments to Army force structures in light of these two views, which he did in two phases. Phase one identified initial steps necessary to transform the current Army structure toward the identified requirements of future warfare. Phase two took a long-term view and outlined key principles underpinning the "future Army" operating in the full spectrum of conflict from 2010 onward. This latter work was presented to the Army Board in September 1997 and is the focus for this article.

Constraints

Western democratic armies are complex organizations subject to political constraints as well as financial limits. The United Kingdom is no exception, and future force-development planning must remain within the agreed funding of the Long-Term Costings Plan, which covers a 10-year period forward. Therefore, program adjustments within this 10-year period have a funding ceiling. An equal if not longer-term constraint is the influence of legacy equipment systems. Many of the key systems delivering our maneuver and firepower will be in service after 2020. Although our thinking may be "out of the box," the scope for action in the short- to midterm is restricted.

"...a long-term constraint is the influence of legacy equipment systems..."

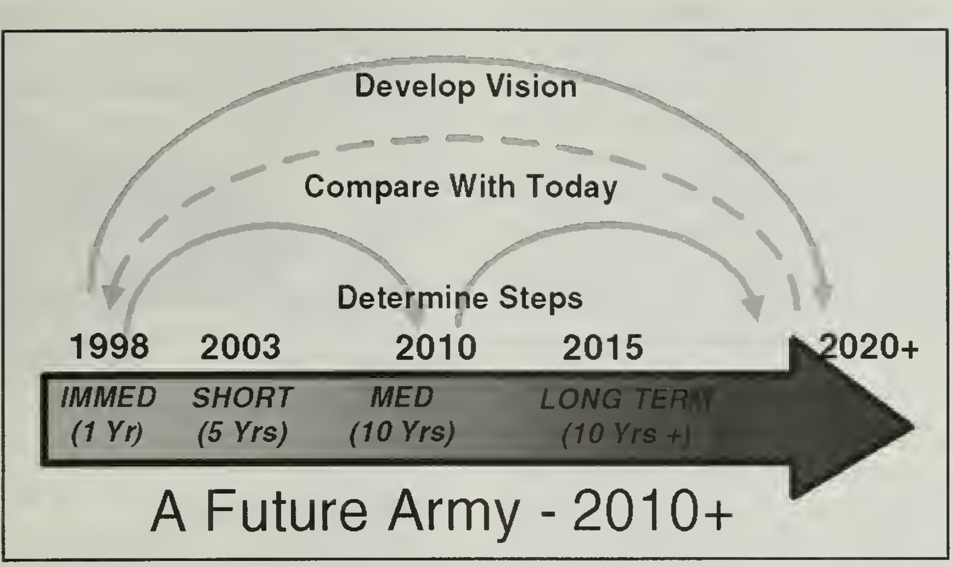

Figure 1

The work described thus far is Army-generated. The new United Kingdom government of May 1997 came to power with the promise of a far-reaching Strategic Defence Review. This ongoing review has taken full account of the future Army work, and we realistically hope that its findings in April 1998 will endorse the precepts. However, it is too early to begin "hardwiring" our future structures, so the details must be addressed later.

The Fundamental Vision

Military concepts will always be constrained by legacy systems and funding limitations, so we must accept evolutionary development rather than a step change. However, that evolutionary development will be guided by an ultimate vision stated as follows:

VISION 2010(+)
A Very Useable Army

The British Army will be:

- World class for its size.
- [Play a] leading role throughout the future security environment—making a difference.
- Core structure based on warfighting in alliance/coalition operations—generating full-spectrum utility.
- Capability based, doctrinally coherent, modular, and robust.
- Top rate people, modern, innovative, outward looking.

Each word of this vision is carefully chosen to guide the progressive development of the Army. Note that it will be "a very useable Army," outward looking, doctrinally coherent, modular, and deployable throughout the spectrum of future conflict. Further work is being done to compare the vision with what we have, weigh the various influencing factors, establish priorities, and hopefully gain a glimpse of how the future Army will be structured (see Figure 1).

Influencing Factors

The following factors will help determine the structure of our future Army:

Strategic Dimension

Strategic guidance will flow from the Strategic Defence Review. Informed assessment suggests that our primary geographic interest for View One types of conflict will remain in Europe, the Mediterranean and its littoral, and the Persian Gulf. However, the wider world cannot be ignored, particularly for View Two types of situations. The United Kingdom exports a higher proportion of its gross domestic product than the United States, Japan, France, or Germany. Overseas investments form a higher proportion of United Kingdom wealth than in any other country in the Organization for Economic Cooperation and Development. In addition, a far greater proportion of our 60 million citizens live and work abroad than that of any other developed nation. Therefore, the international rule of law and stability throughout the world is of fundamental importance to the United Kingdom. A recent influential study set the British Army's endorsed mission types in the following order of importance:

- Security of the United Kingdom and its citizens in peacetime.
- Security of the dependent territories.
- Defence support to wider British interests.
- Support of international order and humanitarian principles.
- Regional conflict outside the NATO area.
- NATO (Article V) regional crisis.
- General war.

Clearly multinational/multiagency operations will become increasingly the norm. Also increasing international interdependence will give the United Kingdom little real choice about its involvement in the full spectrum of future crisis and conflict. It is critical, therefore, that the future Army is postured for warfighting in a multinational context and that it has the modularity to tailor force packages and military contributions to specific theatres or tasks. In addition, it must maintain doctrinal coherence with its principal allies and potential partners, at least at the operational level.

Future Conflict

Warfighting, with all its complex challenges, will remain the ultimate requirement. However, the future Army will be required to operate across the spectrum of conflict from prevention and preconflict to post-conflict activities. The two views of warfare may characterize conspicuous facets of symmetric and asymmetric conflicts, but actual deployments will meet a confusing kaleidoscope of these two views. Often there will be no clear enemy, and victory will be unattainable in traditional terms, with success being measured by the achievement of a desired endstate. Therefore, our small Army (currently 112,000 soldiers) cannot be structured, equipped, and trained for only a limited range of capabilities. The entire Army must have maximum utility throughout the complete spectrum of its possible use.

Doctrinal Principles and Operational Trends

The maneuverist approach to warfare will remain a valid cornerstone of British doctrine—the central theme being to strike at the enemy's will and cohesion rather than match force directly. Therefore, the future Army must maintain superior tempo, agility, and lethality, and it must cultivate the command principles that allow prompt and simultaneous action. Improved technology will be critical in achieving this, but there is concern about overreliance on technology and the possibility of centralized control. Improved technologies should be used to empower the commander's decision-making process and thus support and not supplant the decentralized command philosophy of the British Army.

The identification of an opponent's center of gravity and the decisive points that lead to it will remain critical. Often these vulnerabilities will be in the depth of an opponent's battle space, requiring deep surveillance, maneuver, and firepower. This may require a shift of command emphasis from close to deep operations. Nevertheless, forces must retain the capability for aggressive close combat in order to continue the fight, not only in asymmetric conflict but also in situations where the impact of technology is blunted by urban or close terrain.

"...greater tempo, agility and lethality ...and deep maneuver..."

Challenges of Command

With increased maneuverability and the potency of modern weapon systems, small, self-contained force groupings are likely to exert a much greater influence over wider battlespace areas. Therefore, operational-level thinking and action will be drawn down to lower levels of command. This must be encouraged and not stifled by formulaic approaches that deny open-minded creativity. Similarly, commanders must be trained to develop an appreciation of the operational art in preference to tactical science. This will be extremely important as the following trends develop:

Battlespace. Future battlespace will be multidimensional, including the complex interplay of various national forces and nongovernment agencies. There will be yet greater ground-air integration and a heavy reliance at all command levels on space-delivered information. Commanders will be bombarded with information, and their training and support systems must ensure that a balance is kept between the flow of information and the capability to exploit it.

Balance. The desired balance of acceptability between ends, ways, and means will exercise the minds of commanders at all levels, particularly as the moral dimension cannot—or will not—be defined by political authorities in a timely fashion. Commanders at higher levels must be prepared to take an active and responsible role in shaping public perceptions and opinions at home. Equally, there will be increasing pressure to achieve success for the minimum cost in "blood and treasure." Commanders must weigh the balance between the operational paralysis that results from excessive avoidance of casualties and the consequences of imprudent risk taking.

Changing Society

The profession of arms will remain highly competitive, requiring a fighting spirit and a will to win. However, the Army will need to take account of liberal social attitudes and legislative trends that run counter to this ethos. It will be necessary to articulate a vision of a disciplined, professional, educated, and meritocratic military society, in impartial harmony with the nation it serves and trained to work at the edge of advancing technology.

It may be necessary to develop a contract that recognizes the unique nature of military service and sets out required individual standards. Military technology and sociological trends may make it necessary to review the recruiting, selection, and career paths of officers and soldiers as their relative responsibilities evolve.

Technology

Technology offers exciting possibilities, which are well known in the United States. However, the United Kingdom sees no panacea in pure technology, particularly in an asymmetric conflict. Also, the British government could not support the high cost of pursuing the most advanced technology on a broad front. It would be disproportionate to the military requirement. However, weapons proliferation demands that the United Kingdom retain a qualitative advantage in key capabilities, and it is essential to have continued interoperability with our principal allies in Europe and the United States. With these thoughts, our priorities will be—

- Digitization.
- Robust, improved surveillance target attack radar systems (ISTARS).
- Long-range precision attack.
- Command and control warfare.
- Improved lethality.
- Nonlethal weapon systems.
- Increasingly agile and versatile platforms.
- Logistic improvements.
- Protective systems, including protection against weapons of mass destruction.

Future Army Structures

Early work in the BA 2000 process demonstrated the need for a truly modular Army that can assemble timely force packages tailored for specific operations. Whereas these packages need not be self-contained, they must be capable of generating the tempo, agility, and lethality necessary to dominate future battlespace. Coordination of these force packages in a particular theatre is perceived to be at three levels:

Force (either multinational or national). The force is the level of command needed to synchronize the simultaneous execution of deep, close, and rear operations. Its capabilities and responsibilities will place it at the operational level, and it will be organized functionally with subordinate tactical operations centers to coordinate deep, close, and rear operations separately.

Formation (national). Formations will provide the primary focus for tactical warfighting. They will be the minimum size of coherent, all-arms, national contributions that can be deployed within a multinational joint force. They will be largely self-contained and formulated according to functional purpose.

Unit (national). The unit represents the lowest level at which the tactical maneuver battle can be effectively directed and combined arms fully integrated.

In addition to this highly useable, modular Army, a framework will be needed for force regeneration in times of severe crisis or general war. However, regeneration is increasingly difficult as we become more dependent on small professional forces that operate limited stocks of complex and sophisticated equipment.

Combat service support will be particularly difficult. Its structure must be sufficiently flexible and modular to meet the demands of an Army operating throughout the spectrum of conflict in a variety of force packages. A balanced logistic posture must be achieved in peacetime as a springboard for unforeseen operational requirements. Equally, a pragmatic convergence of national and joint logistic systems, as well as a sure asset-tracking capability to deliver the required equipment in a timely fashion, should be pursued wherever possible. Increased opportunities will be explored for using civilian contractors if their contributions release military resources. Despite their limited personal liability, such contractors bring heightened expertise in logistic planning, complex equipment maintenance, and infrastructure support. Their early involvement may facilitate military withdrawal and a more seamless transition to post-conflict activities.

Engineering Function

Even though it is too early to hardwire force structures, let alone take a definitive view of engineer involvement, the broad function of maneuver support will continue with undiminished importance. How much of that will remain within the Engineer Branch may be questioned. Indeed, it is unclear how the boundaries between established Army branches should be perceived, and it is more logical to take an altruistic view of battlespace functions. There is historical precedent for engineers to develop ideas that are then taken forward in other branches, so some infrastructure support functions might lie elsewhere in the long run. However, a strong engineer belief is that the

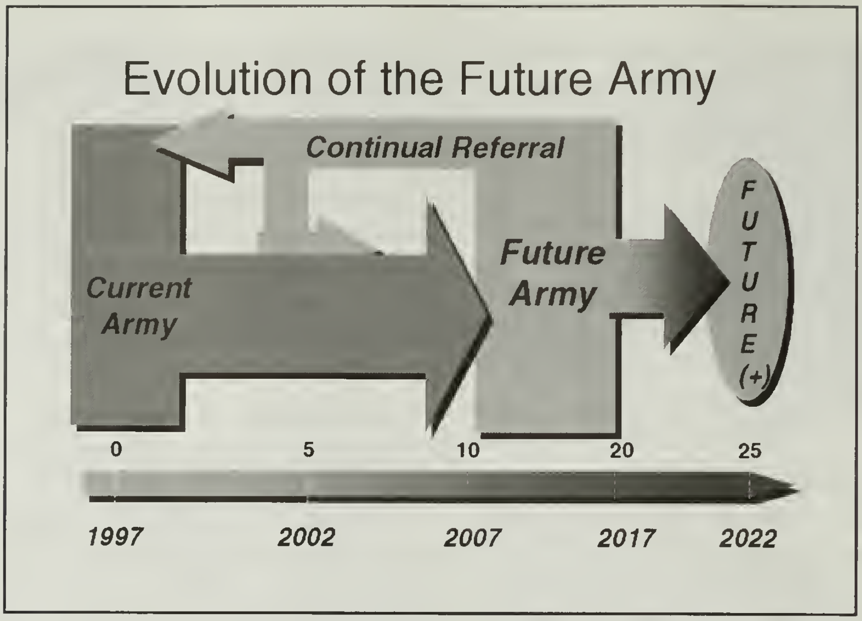

Figure 2

ingenuity of engineering must not be easily subordinated when Army functional responsibilities are rationalized and command structures designed.

The two views of future conflict lead to a polarization of engineer support that runs contrary to the Army policy of maximum utility. On one hand, sophisticated combat engineer skills are required to support tactical maneuver. On the other hand, more general—but equally sophisticated—engineer skills are required to support operational deployment and force sustainment. The broad utility of engineer units may have to accept individual specialties that are more restricting, and the balance of combat and general skills in units will need careful management. Also the demands of supporting theatre entry, in-theatre infrastructure, and post-conflict activities (such as battlefield clearance and reconstruction) reinforce the continuing need for specialized engineer units and advice at the force level.

Equally, tactical agility and operational tempo will demand more integral engineer support to formations and units than before, including the fusing of command and planning functions into all-arms groupings. Again, the policy of maximum utility will require a careful balance between integration and broader utility. This may lead to a continuing need for modularity and force packaging of engineer assets at much lower command levels than occurs in other arms.

The Way Forward

The British Army recognizes the need for change in order to match the evolving nature of conflict. However, change must be balanced, progressive, and coherent, being aware of short-term risks as well as the long-term vision. Technology will support this change but not drive it. Equally, the rate of change will be carefully managed to take full account of necessary interoperability with our principal allies and the preservation of public and political support at home.

Change will be managed through a coherent campaign plan, but not all questions have answers today. There will be a process of continual referrals as implementation exposes new opportunities (see Figure 2). The following design factors will remain central in determining the balance, shape, and size of the future British Army:

- Maximum utility throughout the spectrum of conflict.
- Superior tempo overall.
- Physical and mental agility.
- Structural adaptability and adaptable soldiers.
- Increased lethality through precision, range, and timeliness.
- Protection against the full spectrum of attacks.
- Robustness in all situations and in the articulation of our values and views.

Much of the detail of the change will hinge on how well the Strategic Defence Review supports BA 2000. Whatever the detail, however, change is inescapable.

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Antipersonnel Landmine Policy and Implications

By Dr. Gregory L. Bier

Antipersonnel landmine (APL) policy has been the topic of heated and controversial debate on the international front as well as within the U.S. military. Many question the military soundness of the current APL policy. Many are unsure of the ramifications imposed by the policy to doctrine and training. Others question the intent and future of the policy. This article clarifies the development of the APL policy, its military applications, and its implications for Army units.

Ottawa Process. In September 1997, the United States withdrew from the Ottawa Process. Those negotiations, led by Canada, were aimed at drafting a treaty between "like-minded" nations prepared to ban the use, export, stockpiling, and production of APLs. The United States withdrew from this process after determining that the treaty would not meet its unique national security concerns. The United States had two fundamental concerns. First, without proven and fielded alternatives to APLs, U.S. soldiers in Korea would be faced with a critical capability gap, which would adversely impact our ability to meet unique defense requirements where only 37,000 U.S. soldiers are deployed to defend an enormous border. Second, the treaty would eliminate our ability to use current scatterable mine systems because they include APLs, even though they are self-destructing APLs. Today, the majority of our scatterable mine systems are "mixed," which means they include both self-destructing antipersonnel and self-destructing antitank mines.

U.S. Policy and Law. The level of public awareness concerning APLs has increased dramatically within the last few years. Some significant laws and policy announcements are summarized below:

In 1996, a law sponsored by Senator Patrick Leahy (D-Vermont) was passed that requires a 1-year moratorium on APL use to take effect beginning 12 February 1999. This law (Public Law 104-295) still authorizes the use of APLs in perimeter marked and monitored areas on international borders or demilitarized zones (DMZ). It does not distinguish between nonself-destructing and self-destructing APLs. Therefore, this law effectively prohibits the use of mixed, scatterable systems because they contain antipersonnel submunitions.

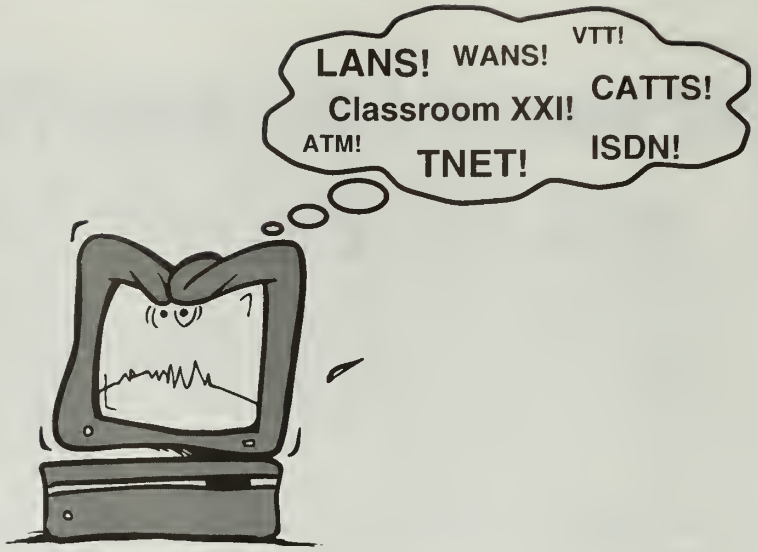
In May 1996, President Clinton directed that the United States unilaterally cease using all nonself-destructing APLs not needed for either demining, countermine training, or for the defense of the United States and its allies from armed aggression that crosses the Korean DMZ. The president also stated that the United States reserves the option to use self-destructing/self-deactivating APLs in military hostilities to safeguard American lives and hasten the end of fighting.

Facts and Figures. With all of the controversy surrounding APLs, it is important that engineers be able to articulate the significance of our national policy. Furthermore, engineers must be able to relate relevant facts and figures pertinent to their combined arms team regarding APLs.

- When used responsibly, landmines are a combat multiplier. Employed correctly, they enhance the use of other weapon systems.
- The Army strongly supports the fundamental objective to eliminate or minimize the maiming of innocent civilians by APLs. To this end, the military has proposed ending reliance on nonself-destructing APLs since February 1952.
- The Army does not support the objective of eliminating reliance on nonself-destructing APLs without first minimizing the risks American soldiers must endure without them.
- Without proven and fielded alternatives in place prior to eliminating APLs, a capability gap would be created, especially in Korea.
- Scatterable mine systems can be employed as directed, situational, or reserve tactical obstacles. Commanders place required limitations on their location, duration, and release as they develop a scheme of employment for each mission. The mines remain on the surface and self-destruct at preset durations. These mine systems have a combined reliability rate of 99.9994 percent and typically have a high metallic content.
- Field Manual 20-32, *Mine/Countermine Operations,* will be updated in May 1998 to incorporate mandated changes in APL policy. The fix, disrupt, turn, and block effects remain unchanged.
- Our mixed systems include antitank mines that are protected by antipersonnel submunitions to inhibit the rapid dismounted breaching of antitank mines by the enemy.
- The Defense Advance Research Projects Agency continues to investigate innovative maneuver denial approaches that are based on advanced technology. However, these efforts will take time and money to develop, test, and field.

Summary. Landmine policy is a dynamic subject. Warfighters must understand and support the policy changes that affect the way we shape the battlefield. Engineers must be intimately familiar with the characteristics, specifications, and employment parameters of the available scatterable mine systems.

Dr. Bier is technical director of the DOD Humanitarian Demining Training Center and Countermine Training Support Center, Fort Leonard Wood, Missouri.


LANS!
WANS!
VTT!
Classroom XXI!
CATTS!
ATM!
TNET!
ISDN!

Training Technology for the Technology Impaired

By Al Waltman

LANS, CANS, ATM, WANS, CATS, CATTS, Classroom XXI, CBT, CAI, CD-ROM, Internet, Distance Learning, Intranet, ISDN, Digital Doctrine, TNET, VTT, VTC...AHHHGGG!!!!!

If you are in data overload because of all the wirehead kinds of things above, join the crowd. Digital technology is outpacing most of our abilities to understand the acronyms, much less what they mean and how they will impact our jobs, our units, and us. By the time you read this article, some of the information in it will no longer be current. Moore's Law states that computer microprocessor speed doubles every 18 months and the price remains constant. That rule has remained valid through eight or nine generations of microprocessors, and based on current press releases, it will continue to hold true. Improvements and changes in other computer hardware and software occur at about the same pace. So how does one keep up? That's our challenge.

It is not possible in a short article such as this to explain all the activities you can expect to see in the next few years in training technology development. We hope to forecast the most significant changes we expect and describe some of the technologies we will use to improve soldier and civilian training across the Engineer Regiment. Distance learning, multimedia training, and training modernization activities will be the focus.

Distance Learning

Distance learning can be defined as delivering the required training to the right student, where and when it is needed. Sounds easy, doesn't it? Let's take this apart and see what's involved.

Current guidance from TRADOC directs that every soldier be trained using a standardized program of instruction that teaches the same tasks to the same standard, no matter where the training is given. Soldiers who graduate from a resident course at Fort Leonard Wood will be trained on the same aspects of their job and to the same standard as soldiers who attend an equivalent course at a Total Army School System (TASS) Battalion. The challenge is to provide quality training to the TASS student while he or she continues to hold a full-time job.

The challenge is not new. For years large corporations have spent millions of dollars on employee education and in-house "corporate universities." Xerox, IBM, and even McDonalds have world-renowned corporate training facilities. Opportunities for normal academic studies are big business. The University of Maryland, Webster University, and Central Texas College are on many military installations worldwide, offering degree programs up to the master's level and vocational training in areas such as auto mechanics and small-engine repair.

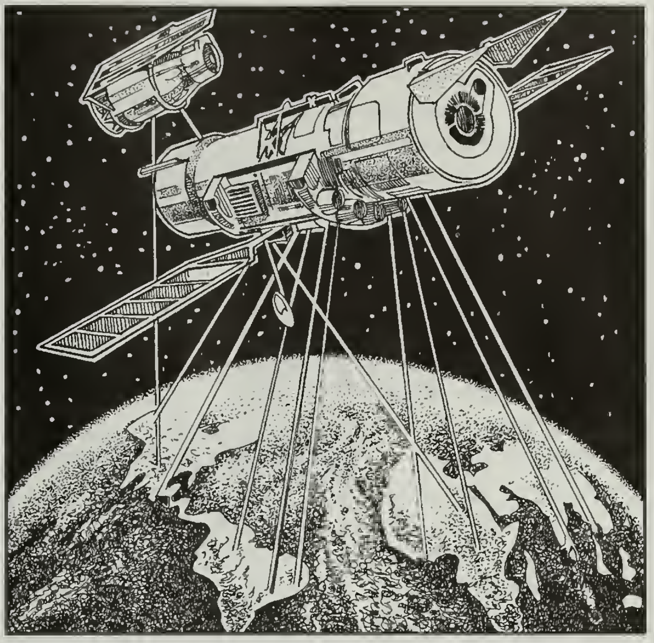
So long-distance learning isn't a new idea. It has just gone high tech. Until recently, the correspondence course was the popular, nonresident training model for the Army, and many soldiers benefited from that program. The Army correspondence course program is still viable as a paper-based system. But correspondence has become a slightly dirty word in the education and training arena, and distance learning with new technologies is gaining credibility.

The challenge that we face is to identify courses that should be trained using distance learning. The amount and kind of training appropriate for this method are determined by the specific tasks to be trained. Distance learning represents a powerful capability when applied with the proper balance of course content and delivery technologies. The Army is spending large amounts of money to convert correspondence course training support material to digital multimedia. This conversion will help ensure that the training is compatible with the needs of our more mobile and technologically aware forces.

As training materials change to digital formats, the delivery medium must change as well. The technology infrastructure the Army is putting in place is reaching a point where many soldiers and civilians can learn wherever they can plug in their computer. Currently 108 military-owned or-operated video-teletraining facilities are located across the United States and Europe. These facilities, linked together in the training network (TNET), provide two-way video and audio capability in either single-location-to-location communication or multiple-location modes. Based on a combination of terrestrial communication lines and satellites, live training can be delivered virtually anywhere a soldier or civilian is located.

The use of electronic networks will become a key element in the delivery of training. Connecting individual students to others gathered in high-technology classrooms, networks will be the means for sharing ideas among students under the tutelage of an instructor located anywhere on the network. Without an electronic backbone, accessing and sharing information will not be possible. Local area networks (LAN) provide connectivity among computers within classrooms and within buildings. Campus area networks (CAN) provide electronic connections between buildings on schools or installations. The wide area network (WAN) provides worldwide connectivity.

In each of these networks, a new technology in data communications called *asynchronous transfer mode (ATM)* allows high-speed, high-volume, two-way data, audio, and video communication connectivity. The goal is to have high-technology classrooms in place that can integrate these networks and provide students with an excellent learning environment. Called Classrooms XXI, they are designed to create a training environment that supports individual soldier learning throughout the total Army. The idea is to move instruction away from the traditional instructor-focused method to one that is student-focused. By involving students in their own training, their understanding of the subject matter is more in-depth and is retained longer.



Classrooms XXI are being built to leverage information-age technologies to gain training efficiencies while maximizing training effectiveness. Between now and 2005, about 30 high-technology Classrooms XXI will be built on Fort Leonard Wood, and several hundred will be built Armywide. Planning and construction have started, and we expect to have more than 15 of these classrooms on Fort Leonard Wood by mid-1999.

Multimedia Training

The evolving technologies of computers, communications, and digital hypermedia have provided new vistas for the design of learning environments. Multimedia presentations can be used with video, high-resolution graphics, and animation to allow students to better visualize physical and logical events, as well as relationships and parts of a system, equipment, or problem. Computer-based training (CBT) and computer-aided instruction (CAI) can be used to enhance or replace instruction with equal effectiveness when proper design considerations are included in the training-development process.

Limited multimedia development capability is in place in the Engineer School, and several products have been developed. All of the Engineer School's programs of instruction are being reviewed for potential conversion to a multimedia format. While contractors will accomplish much of the conversion, the school will maintain the capability to develop lessons or multimedia products to support contingency operations or other rapid-development needs. These products can be designed for delivery via CD-ROM or the Internet.

Training Modernization

Army training is on the edge of its most significant change since World War II. The digital age is providing trainers at all levels with tools never imagined a few years ago. Full-motion simulators of ground combat vehicles are a reality. These high-fidelity simulators are interconnected with other simulators so that soldiers and commanders can fight in a virtual environment.

Sharing instructors between service schools results in a virtual schoolhouse in TRADOC. Multimedia CBT is replacing paper-based correspondence courses. Automation tools such as the Automated Standard Army Training (ASAT) System and Computer-Assisted Training System (CATS) will provide the commander and trainer with detailed training strategies that are event-based and sequentially scheduled to build mission success. These and many other modernization actions will occur in the next few years.

The Engineer School's Director of Training has developed a Regimental Training Modernization Strategy that identifies the most significant needs of the Regiment in individual, unit, and institutional training modernization. The strategy will provide the vehicle for long-term improvements in training both at Fort Leonard Wood and in field units.

One of the first actions was to form an Integrated Concept Team (ICT) with the mission to identify the top training aids, devices, simulations, and simulators (TADSS) needed to train the regiment in maneuver support, force support, and topographic engineering. The team is responsible for developing a prioritized list of training system needs and developing the requirements documents. Only through this type of action can training be truly modernized and brought into the 21st century.

None of us can predict what type of training will be used in the future, but all indicators point toward more training at home stations and using digitized products. Individual training such as the Basic and Advanced Noncommissioned Officer Courses (BNCOC and ANCOC) will continue to have a resident component, but more of the training will be through self-study or video teletraining. Unit and crew training will also be supported by digitized training products. Large-scale, networked, simulation/simulator products will aid in home-station training. TADSS will provide the opportunity for enhanced training through the use of new digital training technology—either as a part of a Combined Arms Tactical Trainer (CATT) or something as extreme as a virtual-construction mission with networked construction equipment.

Glossary of Technospeak

ATM - *Asynchronous transfer mode.* A system of long-distance communication that features high speeds and the ability to simultaneously handle multiple data streams.

Bandwidth - The range of frequencies a circuit will carry. Often used informally to mean the amount of information a network will carry at any time.

CBT - *Computer-based training.* Computer applications that cause learning through the use of graphics, audio, video, and text-based material.

FDDI - *Fiber-distributed data interface.* A standard for a 100-Mbps (mega bites per second) optical fiber ring local area network.

HTML - *Hypertext markup language.* A programming language used by specialized software applications called browsers to create a graphical interface between the user and the World Wide Web.

ISDN - *Integrated services digital network.* A system for combining voice and data transmissions over long-distance lines.

Internet - A worldwide internetwork that interconnects thousands of public and private networks and millions of users.

Intranet - A corporate internetwork that provides the key Internet applications, especially the World Wide Web. An intranet operates within the organization for internal purposes. It can exist as an isolated, self-contained internetwork or may have links to the Internet.

LAN - *Local area network.* A small network, usually of personal computers, that serves a single department or workgroup.

Optical Fiber - A thin filament of glass or other transparent material through which a signal-encoded light beam may be transmitted by means of total internal reflection.

SONET - *Synchronous optical network.* A network transmission system devised for fiber optics.

Teleconference - A conference between persons remote from one another but linked by a telecommunications system. This system may be video, audio, data, or a combination of the three.

TCP/IP - *Transmission-control protocol/Internet protocol.* A widely used pair of protocols used to link networks.

TNET - *Training network.* A two-way audio, two-way video teleconferencing system used by the Army to conduct distance learning.

Twisted Pair - A type of network wiring that uses pairs of twisted wire, similar to telephone wire.

WAN - *Wide area network.* A network that uses long-distance communications methods to operate over large areas, usually connecting parts of a single organization or interest group.

WWW - *World Wide Web.* A networked, graphically oriented hypermedia system. Information is stored on servers, exchanged between servers and browsers, and displayed on browsers in the form of pages of text and images.

The future in training is exciting. At the current rate of growth and technology improvements, can the holodeck be far behind? On the other hand, the leadership role of the chain of command will never be supplanted by a machine. In every case, a human must judge when performance is good enough and when remedial training is appropriate. Only through the judicious use of technology as an aid to training can unit readiness be sustained and improved.

Mr. Waltman is chief of the Instructional Support Division, Department of Training and Doctrine Development. He has 25 years of combined service as an officer and a civilian employee of the U.S. Army Engineer School. Mr. Waltman's areas of expertise are training, operations research, and instructional technology.

Terrain Analysis As a Combat Multiplier Just Got Better

By Major Joseph J. Piek and Captain Dirk E. Plante

"The field is looking to you with great expectations," said MG Robert Flowers, Commanding General of the U.S. Army Engineer Center, at the Defense Mapping School (DMS) at Fort Belvoir, Virginia, on 21 November 1997. The occasion was the graduation of the Army's first Advanced Individual Training class of military occupational specialty (MOS) 81T Topographic Analysts.

The newest MOS in the Corps of Engineers, 81T is a consolidation of two previous MOSs: 81C Cartographer and 81Q Terrain Analyst. The new 81T Basic Topographic Analyst Course (BTAC) couples the most critical elements of cartography and terrain analysis with robust imagery and computer capabilities to bridge the gap from the *manual* topographic methods of the past to the *digital* terrain visualization and information management capabilities of today's Army. The responsibility to produce highly trained, fully qualified 81T soldiers rests with the Defense Mapping School.

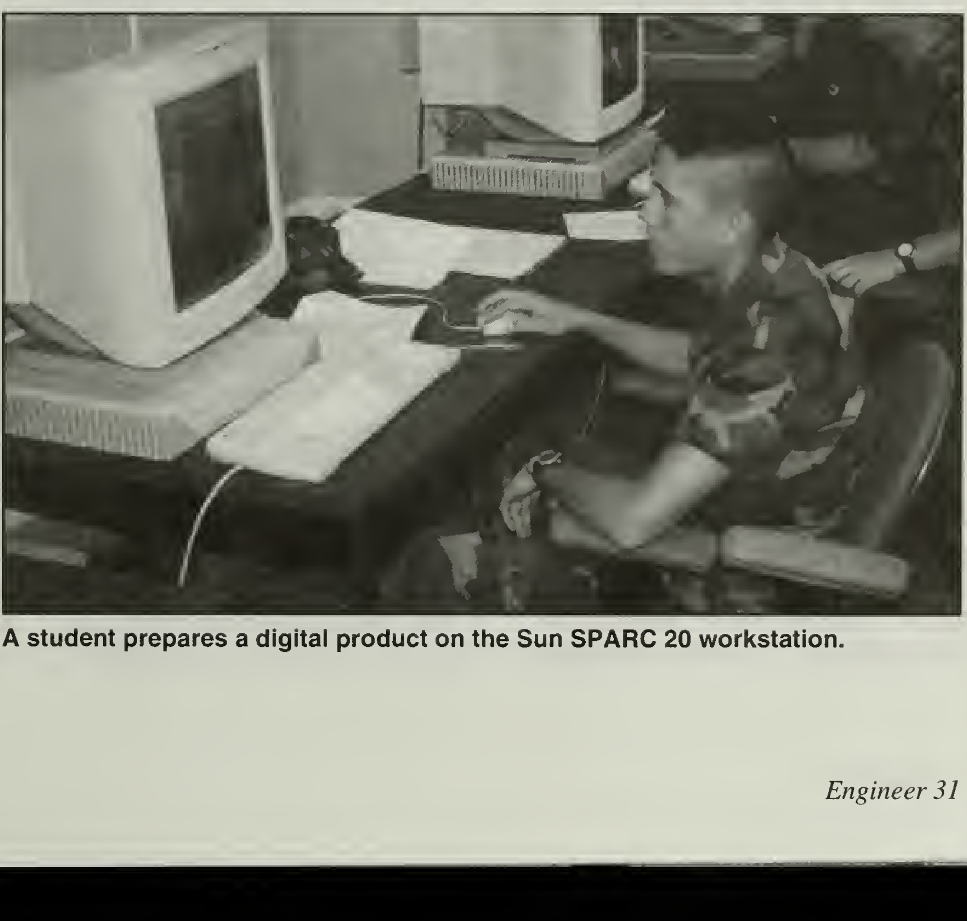


Photo by Andre Piller (NIMA)

A student prepares a digital product on the Sun SPARC 20 workstation.

Defense Mapping School

Established in 1972, DMS is the Department of Defense joint service school that was for many years a training arm of the Defense Mapping Agency. On 1 October 1996, the National Imagery and Mapping Agency (NIMA) was formed, combining the nation's mapping and imagery agencies under one Combat Support Agency. Today, DMS is the largest of four schools in NIMA's National Imagery and Mapping College. It trains members of the Army, Navy, Air Force, and Marine Corps—as well as Department of Defense civilians and international students—in mapping, charting, geodesy; printing technology; and geophysical surveying. Instructors assigned to DMS come from throughout the Department of Defense, including Army and Marine topographic units; Army, Navy, Air Force, and Marine Corps intelligence units; and NIMA cartographic production divisions.

What Is an 81T?

The Topographic Analyst MOS was first proposed in the early 1990s. SGM Ted Poulson, the DMS Sergeant Major, recalls, "The 81C soldier was no longer responsible for making maps, only map revisions, while the 81Q soldier saw an everaccelerating mission for creating terrain analysis products that came about with advances in technology." In reality, Army topographic units already had 81C and 81Q soldiers perform closely related tasks. Evolution in the missions of the two MOSs offered an opportunity for change: to produce soldiers who could provide critical products derived from imagery and other intelligence during the mission analysis process, yet retain the skills to create a map from scratch if required. Consolidation of the two MOSs was approved by the U.S. Army Engineer School in 1995.

The consolidation effort began in April 1997, as 81C and 81Q soldiers Armywide converted to MOS 81T. Soldiers and noncommissioned officers (NCOs) successfully trained by DMS using the new 81T curriculum are immediately awarded the MOS. Additionally, 81C and 81Q sergeants first class and above were automatically awarded the MOS. However, former 81C and 81Q staff sergeants and below who are already in the field and will not have the opportunity to receive formal training at DMS are required to be certified by the first lieutenant colonel in their chain of command before being awarded MOS 81T. Until soldiers are certified, they will carry the Y2 identifier, signifying transition to a new MOS which requires supervised on-the-job training.

The DMS Topography Division began instructing the 81T Advanced Topographic Analyst Course (ATAC) in August 1997 and graduated its first class of 10 students on 18 December 1997. The ATAC is the technical track of the Engineer School's Basic NCO Course (BNCOC). NCOs attend ATAC after completing the core track of BNCOC at Fort Leonard Wood. The 18-week ATAC is unique in that it trains Army, Marine, and international students side-by-side in the same classroom, offering joint training experience for junior NCOs. ATAC students train for 14 of their 18 weeks on the Digital Topographic Support System Multispectral Image Processor. Beyond learning how to master the capabilities of the Army's premier terrain analysis computer system, ATAC students also learn to manage the improved capabilities of the new 81T Topographic Analyst.

81T Course Development

The DMS Topography Division includes Army, Marine, Air Force, and civilian instructors. They had the not-so-simple mission to combine 13 weeks of training for MOS 81C with 16 weeks of training for MOS 81Q and create a course to train the new MOS 81T in just 18 weeks.

Late in 1996, instructors from DMS met with members of the Engineer School's Directorate of Training to determine what tasks 81T soldiers needed to be trained at all skill levels. This Task Site Selection Board selected the essential skills 81T soldiers would need to be successful in topographic analysis detachments at the division level and topographic companies and battalions that support the corps and echelons above corps commanders. The end result was an approved 81T task list—the central element in the entire curriculum-development process. With the push toward digitization of the battlespace under the Force XXI, Army 2010, and Army After Next initiatives, the focus of the new course is on computer skills—rather than cartography and manual terrain analysis skills—needed to manipulate digital data and imagery.

After the 81T task list was approved, warrant officers and NCOs of the topography division took requirements outlined by the Task Site Selection Board and grouped related tasks into 85 separate lessons. Instructors compared the new 81T task list with the curriculum of the old 81C and 81Q courses and found that many of the old lessons remained applicable for manual portions of the new course. However, the lessons needed to be refined, drastically shortened, or updated.

Since the trainers were treading on relatively new ground regarding the computer training portion of the 81T course, many of these lessons needed to be developed. Several computer-training lesson plans were available but had to be revised and lengthened to meet task list requirements. Instructors also built many practical exercises for each computer application so 81T students can strengthen skills in each software application.

More than 3,000 instructor hours were needed to modify existing computer-based instruction and develop new lesson materials. Lesson plans ranging from one hour to several days were created using Microsoft Office software. This software allows instructors to present lessons as PowerPoint slide shows using an LCD projector and instantly change or update course materials.

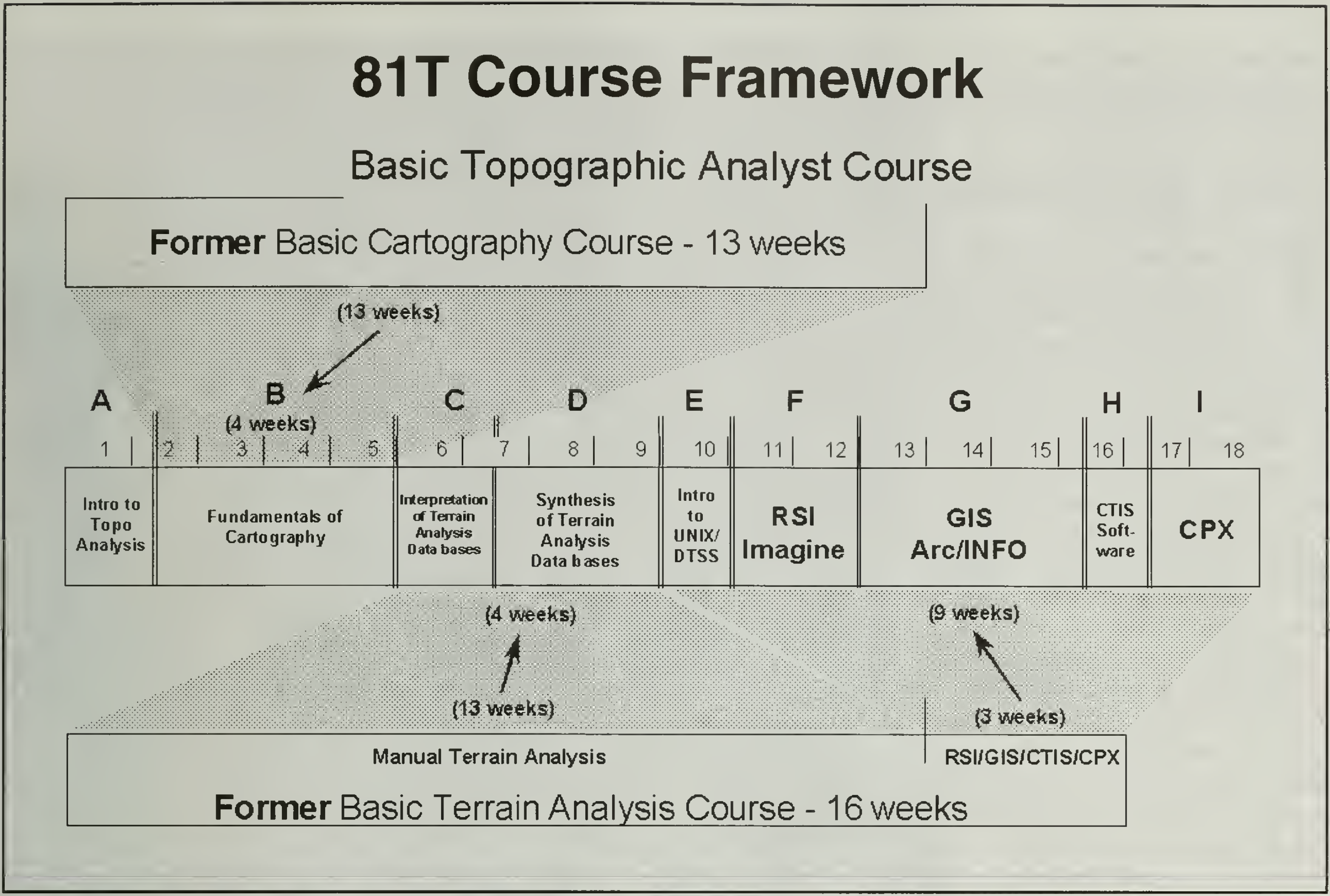
The new 81T course includes more than eight weeks of manual cartography and terrain analysis and more than nine weeks of instruction on computers and software used by 81T students. The time devoted to computer training tripled from that previously provided to 81Q students.

The Marine basic terrain analysis curriculum is called the Basic Topography (BTOPO) Course. Even though the Army BTAC and Marine BTOPO curricula are similar, the Army and Marine Corps basic students are not trained side-by-side because of several differences in the required training for each service. The Marine course is 20 academic weeks, while the Army course is 18 weeks.

Implementation

The 14 soldiers in the first 81T10 course began training in July 1997. The figure on page 33 illustrates how the 18 academic weeks are broken into nine blocks of training. Blocks A through D are the manual portion of BTAC, and E through I are the computer blocks of training.

For the manual portion of the course, soldiers work on light tables with classic cartographer and terrain analyst tools, such as invar bar scales, compasses, pocket stereoscopes,


81T Course Framework
Basic Topographic Analyst Course
Former Basic Cartography Course - 13 weeks
(13 weeks)
A
B
C
D
E
F
G
H
I
(4 weeks)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Intro to Topo Analysis
Fundamentals of Cartography
Interpretation of Terrain Analysis Data bases
Synthesis of Terrain Analysis Data bases
Intro to UNIX/ DTSS
RSI Imagine
GIS Arc/INFO
CTIS Soft-ware
CPX
(4 weeks)
(9 weeks)
(13 weeks)
(3 weeks)
Manual Terrain Analysis
RSI/GIS/CTIS/CPX
Former Basic Terrain Analysis Course - 16 weeks

straightedges, and scribers. They construct map grids, scribe map features, create factor overlays, and determine intervisibility.

In the automated or computer portion of the course, soldiers train on state-of-the-art UNIX-based Sun Microsystems workstations, including the SPARC 20 and ULTRA 1 computers. They work at individual workstations, whereas during previous 81Q computer training lessons, two or three soldiers trained together on each computer system. The topography division has adopted a one-student-per-workstation policy to maximize hands-on time. This approach results in each soldier receiving more than 300 hours of individual computer instruction during the 81T class—a 600 percent increase over the previous 81Q course. Soldiers receive training in Remotely Sensed Imagery, Geographic Information Systems, and Combat Terrain Information Systems software. They learn to produce critical products used during the mission analysis process, specifically during the intelligence preparation of the battlefield (IPB). Block I, the Command Post Exercise, is a 10-day final exam requiring that soldiers produce nine IPB products, including a combined obstacles overlay, cover and concealment overlay, elevation layer tint, line-of-sight overlay, and minefield overprint.

To ensure that soldiers received the training specified and enough time was allotted for individual lessons, the topography division staff evaluated the lesson plans for content and length after each block of instruction during the first 8IT class. These evaluations served as an internal after-action review. They were combined with comments from soldiers in the class to improve the course content for BTAC students in 1998. The topography division is working with several field units to provide copies of the BTAC lessons for their 81T supervised on-the-job training, as well as other unit training.

Topographic Analyst Graduation

The 14 graduates of BTAC Class 1-97 were inspired by General Flowers' stories of the key roles their forerunners played in successful operations from World War II through Desert Shield and Desert Storm. He reminded the new graduates, "The first soldiers stood up for deployment (for these operations) were topographic soldiers flown to Bahrain to begin the intelligence preparation necessary for operations in the Persian Gulf area." Colonel Robert Kirby, Commander and Deputy Director of the U.S. Army Topographic Engineering Center in Alexandria, Virginia, described how the mapping community has evolved—since he was a student studying celestial navigation to today where "We live in a world of Global Positioning Systems, multispectral analysis, and new technology that helps us do our job better." He concluded by saying, "The tools of our trade may change, but our fundamentals and purpose have not."

Strength Through Knowledge

Topographic analyst support to the combined-arms team is critical. Alongside the combat, general, and construction engineer MOSs, the timely and accurate terrain information provided by 81T soldiers is a combat multiplier that gives the commander a decisive edge over the enemy. When the commander can visualize the terrain and understand its impact on both friendly and enemy operations, the topographic analyst has done his job.

In 1998, the Defense Mapping School Topography Division will conduct five BTAC and two ATAC classes and train nearly 100 of the Army's newest soldiers, the 81T Topographic Analysts. MG Flowers said it best at the first 81T graduation, "Our Army must be able to dominate terrain to be successful, and you're the ones who will make that happen."

Major Piek is the Chief, Topography Division, Defense Mapping School, Fort Belvoir, Virginia. Previous assignments include the Office of the Chief of Public Affairs at the Pentagon; Commander, 70th Engineer Company, 29th Engineer Battalion, Fort Shafter, Hawaii; and Survey Company Executive Officer, Battalion S4, and Platoon Leader, 30th Engineer Battalion. MAJ Piek holds a master's degree in journalism from Marshall University, Huntington, West Virginia.

Captain Plante is the Deputy Chief, Topography Division, Defense Mapping School. Previous assignments include Commander, Company B, 37th Engineer Battalion, Fort Bragg, North Carolina; and Executive Officer, Company D, and Platoon Leader, Company A, 237th Engineer Battalion, Heilbronn, Germany. CPT Plante holds a bachelor's degree in physics from Texas Christian University, Fort Worth, Texas.

Letter To The Editor

An article in the November 1997 issue of Engineer by Lieutenant Corr (Engineer Qualification Tables: A New Training Methodology) caught my attention. While the author correctly credited the Engineer Brigade with development of the EQT, the grayed side bar on page 30 and the endnote on page 31 attributed development to the 10th Engineer Battalion. Here are the facts:

Colonel Carl Strock (now BG Strock), Captain Matt O Brian and Sergeant First Class Mike Bergeron developed those tables while in the Engineer Brigade for the 3rd Infantry Division (formerly the 24th ID) at Fort Stewart. We began work in August 1995 and tested the tables on two battalions, the 11th Engineer Battalion in July 1996 and the 317th Engineer Battalion in October 1996.

The key to success was designing them to match existing tables that infantry and armor units already used and understood. The EQT had an immediate impact at Fort Stewart and Fort Benning (home of the 317th Engineer Battalion and the 3rd Brigade) by getting us range and ammunition resources previously denied to us. We intentionally designed the tables to match the resource limitations in DA PAM 350-38. As for comments by active duty engineers that the tables are redundant, that was the whole point. The tables are grouped (like the maneuver tables) into individual/leader skills, section/squad skills, and platoon training. Within those groups are tables that allow the leader of that unit to first train (practice) on his own, then be certified as ready by his next higher headquarters, and finally qualify to standards using evaluators from the headquarters two levels up.

The hardest part of our year-long development and testing process was getting agreement on what skills we should include to make engineer squads/platoons qualified. It came down to those tasks that COL Strock decided (as the commander) should be included. We sent the whole package to the Engineer School back in June 1996 (POC Mr. Rayburn Toy).

Major Bob McCarty
Operations Group Bravo
Battle Command Training Program
Fort Leavenworth

Engineer School s reply:

You are right on target. The EQTs were developed by you and staff in the Engineer Brigade, 3rd ID, at Fort Stewart. We are thankful for your concerted effort. Your tables stand as the basis for the final product we will distribute during the third quarter of FY98 in a new publication TC 5-150, Engineer Qualification Tables. The staffing actions of your tables and the many variations we received from units throughout the force enabled the Engineer School to publish a common standard for combat engineers.

The measurement of relevant training, as applied to the tables, instills many training captains to unintentionally apply words of ownership or authorship to successful events. Again, thank you for your effort and continued support.

Rayburn Toy
Training Specialist
Collective Analysis Branch
Department of Training and Doctrine Development

Engineers and the Berlin Airlift, 1948-1949

Fifty years ago, in June 1948, one of the most dramatic episodes in the history of the Cold War began in central Europe. The Soviet Union cut off ground access to the western sectors of Berlin, isolating western military forces and more than two million civilians deep within the Soviet zone of occupation. Anxious to avoid war but determined to stand up to the Soviet threat, the western powers resorted to an airlift of unprecedented scope to keep the city supplied. For more than a year American and British planes shuttled food and coal to the city, confounding the Soviets who were convinced it could not be done. Engineers played an important role in the airlift by building and maintaining airfields in West Berlin under difficult circumstances.

By William C. Baldwin

At the end of World War II, the victorious powers divided Germany into four zones of occupation, but the capital of Germany, also divided into four sectors, was deep within the Soviet zone. Although the western allies— Britain, France, and the United States—received formal rights of air access to their sectors in Berlin through three air corridors, the Soviets never guaranteed access by land. As tensions between the former allies intensified in the years after 1945, Germany and Berlin became the stage on which the Cold War opened. Extension of the American recovery plan for Europe, the Marshall Plan, to the western zones of Germany and western intentions to establish a new German government in their zones, led the Soviets to counter with increasing pressure on the western sectors of Berlin. After interfering with rail and highway access in the spring of 1948, the Soviets began an almost total ground blockade on 24 June. Some western leaders, such as General Lucius Clay, the American commander in Germany, wanted to break the blockade with armed force if necessary. President Harry Truman and the joint chiefs of staff wanted to avoid military confrontation but stay in Berlin.

The only alternative was an airlift. During the war, an airlift had been used to send supplies over the hump of the Himalaya Mountains from India to China, but never on the scale necessary to feed and power a city of more than two million people. Convinced by the German failure to supply their troops trapped in Stalingrad by air during World War II, the Soviets anticipated victory, and not all western leaders were confident that the airlift would succeed.

"Operation Vittles," as the airlift was officially dubbed, faced formidable

These women in West Berlin work in shifts around the clock to help build the Tegel airfield using brick rubble taken from destroyed city blocks.

obstacles. General Clay estimated that it would take at least 4,500 tons of supplies a day to provide a minimum of food and heat for the city. The American transport planes that carried most of the cargo, C-47s and C-54s, could carry only 3 and 10 tons, respectively, per aircraft. The Air Force put Major General William H. Tunner, the architect of the Himalayan hump airlift, in charge of the Berlin operation. Nicknamed "Willie the Whip," Tunner demanded that the airlift operate like clockwork with no delays or lost time. Even though the western allies could use three air corridors to reach Berlin, the city had only two airfields that could receive flights. Airfield maintenance and construction, therefore, were key to the airlift's success.

Two airfields were available in the summer of 1948: Gatow, in the British sector, and Tempelhof, in the American sector. Tempelhof had been an important civilian air terminal in prewar Germany but had suffered heavy damage from bombing during the war. After the war, the 852d Engineer Aviation Battalion rebuilt the prewar sod field with a base of crushed rubble covered with concrete and pierced steel plank (PSP), a wartime material used for expedient airfield construction. This airfield quickly deteriorated during the airlift under the steady pounding of landings and takeoffs by heavily laden planes. To keep the airfield open, engineers placed crews along the runway to fill holes with sand and bitumen and to straighten and weld bent and twisted pieces of PSP. Crews raced onto the runway between flights and completed repairs while one crew member watched for the next approaching plane. As the volume of airlift traffic grew, the single runway at Tempelhof proved inadequate.

On 8 July 1948, U.S. Army engineers in Berlin received orders to build another PSP runway at Tempelhof. Colonel Reginald Whitaker, the engineer of the Berlin Military Post (the equivalent of today's Director of Public Works) and his relatively small crew of Army engineers were responsible for the construction. The new runway, 5,500 feet long and 140 feet wide, was completed on 12 September, and a third runway, paved with asphalt, was begun in late August and completed in November. But Gatow and the expanded Tempelhof airfields could not accommodate the rapidly growing volume of supplies that the airlift brought to Berlin.

In late July, engineers began searching for a location for a new airfield and found a suitable site on a former German army installation at Tegel, in the French sector of Berlin. The Tegel site was more open than either Tempelhof or Gatow, which were closely surrounded by buildings. When engineers reported to General Clay that the new airfield could be completed by February 1949, he replied that their estimate for construction time was "much too long." The new target date was December 1948.

Completion of an entirely new airfield in such short order placed additional strain on the already heavily burdened engineers. The post engineer assigned 15 officers, 150 soldiers, and some heavy equipment to Tegel, but these resources were not adequate. Construction equipment and materials, such as asphalt and cement, were heavy and competed with food and coal for airlift priority. Construction at Tegel began in August using readily available resources—the hand labor of thousands of Berliners and rubble from destroyed sections of the city.

Recruited with the promise of 1.20 marks per day and a hot meal, about 17,000 Berliners, half of them women, worked in shifts around the clock building the airfield. The base course of the runway was brick rubble compacted to a depth of two feet. Ten square city blocks of rubble were consumed to build the base course.

Material for the next course of the runway came from ballast from unused railroad tracks. Major General Norman Delbridge, a retired engineer officer, was a lieutenant in Berlin during the airlift. He described the activities of one of his crews composed of "about 60 little old ladies." The women had difficulty bending over, so the engineers put longer handles on the hammers they were issued. Delbridge lined the crew up "all the way across the runway, elbow to elbow, and they would walk forward slowly" examining the compacted ballast. Some of the ballast had not compacted properly, "so their job was to come up to that little piece of ballast and go 'tink' with the ball peen hammer and crack that piece of ballast

Crew works on a pierced-steel plank runway as an airplane lands at Tempelhof airfield.

so that when you came through with the asphalt, it would penetrate."

The asphalt came from 55-gallon drums flown into the city and heated in kettles over open fires—a dangerous operation. To obtain material for the runway's surface, engineers tore up miles of cobblestone streets and crushed the cobblestone in small, portable crushers they called "peanut crushers." Russian protests against using ballast were ignored as were their protests when the French unceremoniously blew up a radio tower that obstructed the runway at Tegel. The tower belonged to Radio Berlin and was manned by the Soviets. "The French came out there with their engineers," Delbridge recalled, "marched the Russians out at bayonet point, went in, and blew down that tower."

Although the unskilled labor of thousands of Berliners was critical to the construction at Tegel, the engineers still needed heavy equipment. Post engineers in the American zone of Germany and the Hanau Engineer Depot had large quantities of heavy equipment left at the end of World War II, but getting the equipment to Berlin was not easy. Much of it would not fit in the transport planes, so engineers disassembled the large equipment in Hanau and reassembled it in Berlin. Some 40 pieces of equipment, including tractors, graders, rollers, scrapers, asphalt distributors, and rock crushers, were flown to the city. By late November, ahead of Clay's expedited schedule, Tegel began to receive planes, and the airfield was formally dedicated in December.

Dedication of the first runway at Tegel, with its associate aprons and taxiways, did not complete the engineers' airfield mission. In March 1949 construction began on a second, 6,500-foot runway at Tegel, which engineers constructed largely with equipment airlifted into the city. No longer did engineers need to rely so heavily on the labor of West Berliners. In May engineers began rebuilding the original runway at Tempelhof. In the western zones of Germany, engineers built barracks and support facilities for the air crews flying to Berlin and improved facilities at airfields where planes were loaded and headed for Berlin. Without these airfields and support facilities, the airlift would not have been a spectacular success.

After a hesitant start, the Berlin airlift rapidly gained momentum. On 7 July 1948, the airlift exceeded 1,000 tons delivered in one day. By the end of the month it had reached almost 2,000 tons. Finally, on 12 August, American and British planes delivered more than 4,500 tons, the figure that General Clay thought was necessary to sustain the city. In spite of severe winter weather, the airlift continued to surpass its own records, reaching its peak on Easter Sunday, 16 April 1949. In that "Easter Parade," General Tunner's crews delivered almost 13,000 tons of supplies in a record 1,398 flights. Almost one plane per minute landed at Berlin's airfields during this remarkable 24-hour period, demonstrating that the airlift could furnish more than the needs of West Berlin's isolated citizens.

Acknowledging that their strategy of starving Berlin citizens had failed, the Soviets announced in early May that they would lift the blockade on 12 May. Apprehensive that the Soviets might reinstate the blockade, General Clay ordered the airlift to continue until the city had built up a reserve. The pace of the airlift slackened throughout the summer and finally, on 30 September 1949, the last airlift C-54 landed in Berlin. From June 1948 through September 1949, American and British planes carried 2,325,000 tons of cargo to West Berlin in almost 300,000 flights. Their achievements convinced the Soviets of both the resolve and the capabilities of the western allies. U.S. Army engineers made an important contribution to this early American victory in the Cold War.

Suggestions for Further Reading:

Robert P. Grathwol and Donita M. Moorhus, *American Forces in Berlin: Cold War Outpost, 1945-1994,* Washington, D.C., 1994, 200 pages.

James F. Holly, "Airlift of Heavy Equipment to Berlin," *The Military Engineer,* Vol. 51 (March-April 1949), pages 79-83.

Roger D. Launius, "The Berlin Airlift: Constructive Air Power," *Air Power History,* Vol. 36 (Spring 1989), pages 9-22.

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Training Support Brigades:

Providing Engineer Support to Reserve Components

By Major Shawn Howley, Captain Paul Baker, and Captain Joseph E. Staton

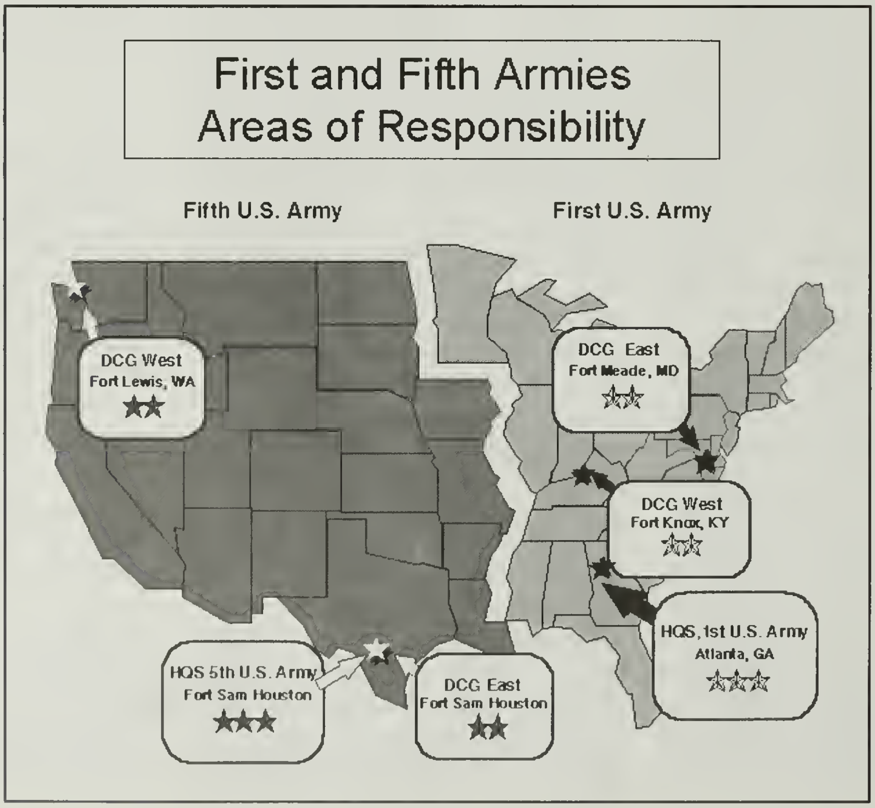
In October 1997, the Army's two Continental U.S. Armies (CONUSAs)—First and Fifth—restructured many of their subordinate commands to enhance support to Reserve Component (RC) training—U.S. Army Reserve (USAR) and Army National Guard (ARNG). The resulting force structure and mission change eliminated overlapping efforts of the Regional Training Brigades and Readiness Groups. The Regional Training Brigades formerly focused on annual training (AT) and inactive duty training (IDT), including lanes training and evaluation. The Readiness Groups supported the RC units with training assistance and Training Assessment Models (TAMs). The new organizations, called Training Support Brigades (TSBs), provide RC units with a "one-stop shop" for branch and functional training assistance, TAMs, AT, and IDT lanes training and evaluation.

FORSCOM is the major Army command responsible for ensuring that both active and reserve forces are capable of responding rapidly to any crisis worldwide. For RC forces, this responsibility is executed within the United States by the two CONUSAs, which train, mobilize, and deploy RC units within FORSCOM. Each CONUSA executes FORSCOM missions within its geographic area of responsibility. The figure below shows the Army areas of responsibility within the respective headquarters.

This article describes the engineer support structure of two TSBs: First Army's 174th Infantry Brigade at Fort Drum, New York; and Fifth Army's 479th Field Artillery Brigade at Fort Sill, Oklahoma.

First U.S. Army

First Army organized the TSBs as infantry, armor, cavalry, or support brigades. A typical TSB consists of about 250 personnel with military occupational specialties (MOSs) tailored to best support the client units within each organization's area of responsibility.



174th Infantry Brigade

The 174th Infantry Brigade has five battalions located in New York and New Jersey.

- Fort Drum, New York—1st Battalion (Infantry), 3rd Battalion (Field Artillery), and 4th Battalion (Forward Support).
- Syracuse, New York—2d Battalion (Infantry) (offers direct support to the 27th Separate Infantry Brigade, an Enhanced Brigade).
- Fort Dix, New Jersey—5th Battalion (Combat Support/ Combat Service Support [CS/CSS]).

Mission

Each battalion focuses on teaching and coaching the reserve unit's leadership to enhance individual and unit mission training, which equates to unit readiness. Special emphasis is placed on training assistance, training management, leader development, lanes development, and evaluations to priority and nonpriority RC units in New York and New Jersey.

During the AT period, which is between May and September, the brigade's primary mission is lanes training and training support to RC units. Observer-controller teams within each battalion synchronize and evaluate priority RC units on collective, leader, and individual tasks. Coordination for the AT begins 24 months before it is performed and includes synchronizing actions between the engineer observer-controllers, the CSS observer-controllers, the TAM evaluator, the client unit, and the opposing forces.

Additionally, each TSB provides a staff and operations structure for Annual Training Evaluation Headquarters and/ or Active Component Control Headquarters at selected training sites and Mobilization Assistance Teams (MATs) to selected sites. The TSB also provides military support to civil authorities (MSCA) as part of the Department of Defense's (DoD's) response to national or regional emergencies.

Engineer Structure

The brigade engineer establishes and manages the engineer support structure for the TSB. Managing this structure requires a working knowledge of combat support and combat service support operations and a broad understanding of RC engineer support to the Corps of Engineers structure. The brigade engineer helps units plan, coordinate, and evaluate training for engineer units ranging from engineer teams to engineer brigades. Examples of the types of supported units are—

- Light—827th Engineer Company
- Mechanized Combat—479th and 152d Engineer Battalions
- Combat Heavy—306th Engineer Company and 204th Engineer Battalion
- Asphalt—770th Combat Support Equipment Company
- Real Estate Team—305th Engineer Team

In the 174th Infantry, engineer support focuses on designated RC priority units (force support package, roundout/roundup units, enhanced brigades, and units with a latest arrival date less than 30 days [LAD 30]) and nonpriority units. The brigade's two engineer companies provide training assistance and evaluations for RC engineer units within its area of responsibility. If additional assets are required, the brigade engineer coordinates for external resources. For example, the 2d Battalion (Engineer), 15th Support Brigade, provides general combat engineering training assistance and lanes support to select force support package combat engineer and bridge units in an 18-state area, which includes the 174th's area of responsibility.

Training Support

Training support focuses on improving the proficiency of RC units in individual, leader, and collective tasks during home-station training. Proficiency varies based on the type of unit: combat arms units train to platoon-level standards; CS and CSS units train to company-level standards. The brigade engineer orchestrates assistance visits from the two engineer companies, provides additional support from the 2d Engineer Battalion when required, and ensures that training objectives, a mission, and an end state are developed for each visit. Assistance may range from "training the trainer" to evaluation of a collective task. The brigade engineer analyzes the mission based on mission, enemy, terrain, troops, and time available (METT-T). This tool allows him to manage resources (unlimited requests versus limited dollars and personnel) and focus the assistance visit on the units' mission essential task list crosswalk. External lanes evaluations of collective unit skills are performed during both a weekend drill and the summer annual training period. Lanes evaluations are planned, constructed, and executed by observer-controllers from the 2d Engineer Battalion.

Mobilization Assistance Teams

During a federal call-up of RC units, the 174th establishes a mobilization assistance team to assess the training status of the unit, help the RC commander refine his "post-mobilization plan," and support mobilization training. Engineer units leaving the mobilization center must be operationally ready and able to provide adequate engineer support.

Military Support to Civil Authorities

During MSCA operations, the 174th Infantry Brigade assists the Federal Emergency Management Agency (FEMA) in New York and New Jersey. The brigade engineer provides

Engineer Points of Contact

First U.S. Army

Training Support Brigade	Telephone	Address/e-mail
3rd Support Brigade	Commercial (978) 796-3013 DSN 256-3013	Fort Devens, Massachusetts e-mail: maddend@devens-emh3.army.mil
174th Infantry Brigade	Commercial (315) 772-7815 DSN 341-7815	Fort Drum, New York e-mail: howleys@drum-rgrtb.army.mil
15th Support Brigade	Commercial (717) 770-5989 DSN 923-5989	Fort Meade, Maryland e-mail: westfalr@tsbncpa-ex1.army.mil
4th Cavalry Brigade	Commercial (502) 626-2204/2235 DSN 536-2204	Fort Knox, Kentucky e-mail: leatherl@ftknox-emh9.army.mil
157th Infantry Brigade	Commercial (803) 751-4372 DSN 734-4372	Fort Jackson, South Carolina e-mail: tsbjen-s3@rgj.army.mil
205th Infantry Brigade	Commercial (317) 532-4064 No DSN	Fort Benjamin Harrison, Indiana e-mail: wrayr@harrison -emh1.army.mil
12th Support Brigade	Commercial (608) 388-3696/3555 DSN 280-3696	Fort McCoy, Wisconsin e-mail: rielandb@server1-tsb.mccoy.army.mil
158th Infantry Brigade	Commercial (407) 494-3145 DSN 854-3145	Patrick AFB, Florida e-mail: perryb@rgpat.pafb.af.mil
177th Armor Brigade	Commercial (601) 558-4337 DSN 921-4337	Camp Shelby, Mississippi e-mail: bickell@rgred.redstone.army.mil
189th Infantry Brigade	Commercial (910) 396-5284 DSN 236- 5284	Fort Bragg, North Carolina e-mail: sullivanp@rgbragg.bragg.army.mil

Fifth U.S. Army

Training Support Brigade	Telephone	Address/e-mail
5th Armor Brigade	Commercial (719) 526-9339/0188 DSN 691-9339/0188	Fort Carson, Colorado e-mail: barnettm@tsb-carson.army.mil
21st Support Brigade	Commercial (510) 466-4442/4267 DSN 859-466-4442/4267	Oakland Army Base, California e-mail: guren@lewis-5Awest.army.mil
120th Infantry Brigade	Commercial (210) 221-9019/2699 DSN 421-9019, 471-2699	Fort Sam Houston, Texas e-mail: hyattj@samhou-usafive.army.mil
166th Aviation Brigade	Commercial (785) 239-3510/8672 DSN 856-3510/8672	Fort Riley, Kansas e-mail: drucem@riley-emh1.army.mil
191st Infantry Brigade	Commercial (206) 967-6357/3279 DSN 357-6357/3279	Fort Lewis, Washington e-mail: berry@5army-lewis.army.mil
479th Field Artillery Brigade	Commercial (580) 442-2419/3503 DSN 639-2419/3503	Fort Sill, Oklahoma e-mail: alcone@doimex1.sill.army.mil

Sappers of B Company, 479th Engineer Battalion, conduct breaching drills during engineer annual lanes training.

engineer information, communication linkages, and DoD resource support to FEMA. He provides information on the DoD engineer capabilities and resources and must be familiar with activities described in Field Manual 100-19, Domestic Support Operations.

Fifth U.S. Army

Fifth Army assists, evaluates, and synchronizes all training support activities of RC units west of the Mississippi, excluding Minnesota. It also directs mobilization and deployment planning and, on order, executes mobilization operations. Since 8 December 1995, Fifth Army has helped train and mobilize 3,130 RC soldiers to support peacekeeping operations in Bosnia. In addition, the command has mobilized 219 individual soldiers to fill vacant U.S. Army Europe positions.

The TSBs are vital to Fifth Army's ability to execute such diverse and critical responsibilities. Of the six brigades within Fifth Army, three are combat service/combat service support, one is aviation, and two are combat arms.

479th Field Artillery Brigade

The 479th Field Artillery Brigade—which consists of about 200 officers, noncommissioned officers (NCOs), and civilians—has five battalions on military installations and USAR Centers in Oklahoma, Texas, and Kansas.

- Fort Sill, Oklahoma—1st Battalion (Field Artillery/Multiple-Launch Rocket System [MLRS])
- Fort Riley, Kansas—2d Battalion (Field Artillery/MLRS)
- Oklahoma City, Oklahoma—3rd Battalion (CS/CSS)
- Dallas, Texas—4th Battalion (CS/CSS)
- Houston, Texas—5th Battalion (CS/CSS)

Mission

The 479th Field Artillery Brigade's mission includes training assistance and evaluation, pre- and post-mobilization assistance, and MSCA during federal disasters. The brigade assists units throughout the region to improve readiness and apply doctrinal theory to real situations. The brigade assists engineer units and also mobilizes RC soldiers from other branches for various types of contingencies.

Engineer Structure

The rank, branch, and MOS structure within the 479th Field Artillery Brigade is diverse. A field artillery colonel currently commands the brigade, and a variety of branches and MOSs fill the brigade staff sections. Most officer positions are coded as branch immaterial. Each brigade has a different MOS mix depending on its client base. Numerous positions are available to engineers within the brigade. Almost any position in the S3 is open to engineer officers and NCOs. While the table of distribution and allowances for the CS/CSS battalions is not finalized, each battalion will have at least one engineer officer and possibly as many as three. One company (sometimes two) of each battalion is engineer-based, with two engineer officers and four NCOs from career management field 51.

Training Support

The 479th is responsible for lanes training for all Army National Guard MLRS units in the Fifth Army area. The CS/CSS battalions assist the 75th Division (Exercise) Training Brigades (USAR), executing lanes training exercises for high-priority CS/CSS units in Oklahoma, New Mexico, Texas, Arkansas, and Louisiana. Engineers assigned to the CS/CSS battalions have a direct impact on unit readiness, lanes execution, and branch assistance. Engineers make up 25 percent of the high-priority units in the 479th's client base, with each unit conducting lanes training and receiving a Training Assessment Model every year. The CS/CSS battalions not only coach, mentor, and assist units, they also provide Combat Training Center quality evaluations (observer-controller/trainer). Beginning in FY99, they will provide TAM evaluations to all high-priority client units.

Mobilization Assistance Teams

TSBs are responsible for mobilization assistance to both the unit being mobilized and the installation commander. All Bosnia mobilizations currently occur at Fort Benning. Deployment does not begin until the installation commander verifies the unit's readiness, based on feedback from the Mobilization Assistance Team and the installation staff.

The S3 section is the doctrinal proponent within the brigade for mobilization training. This section trains brigade personnel to provide courtesy file reviews and trains unit leaders on mobilization responsibilities. The S3 section also helps develop the unit's mobilization plan. The purpose is to improve the quality and completeness of the unit's mobilization files and determine if the unit's plan is both workable and executable. During an actual mobilization, teams deploy to the unit's home station to provide assistance before moving to the mobilization station. The team officer in charge normally deploys to the mobilization station and remains with the unit until it deploys to the assigned theater.

Military Support to Civil Authorities

The 479th provides MSCA by keeping soldiers trained to deploy as part of a Defense Coordinating Element anywhere in FEMA Region VI (Oklahoma, New Mexico, Texas, Arkansas, and Louisiana). A presidential declaration is required to activate the element, which provides a supporting operational staff for the Defense Coordinating Officer (DCO). As the focal point of the DoD response to a presidentially declared disaster, the DCO coordinates the MSCA effort with the Federal Coordinating Officer (FEMA official) and the federal response community. The DCO ensures that military support requirements are mission essential and supplied as efficiently as possible. The Defense Coordinating Element validates, coordinates, tracks, and reports the progress of all DoD assets tasked to conduct MSCA operations.

One Army, One Standard

Within the Training Support Brigades, numerous challenging opportunities offer engineers professional development and allow them to directly impact RC readiness. The new TSB concept was established to provide effective assistance and evaluations to Reserve Component units. Active Component soldiers assigned to the TSBs have the opportunity to teach and coach while learning how the Reserve and National Guard soldiers train to one Army standard. By understanding the linkages between Reserve Component units and how they work hand-in-hand with the Active units, we will build a more cohesive Army. We have one Army and one standard. We stand together as the world's best army, a full-spectrum force trained and ready for victory. A total force of quality soldiers and civilians.

Major Howley is the executive officer of the 4th Forward Support Battalion, and brigade engineer, 174th Infantry Brigade, Fort Drum, New York. Previous assignments include: chief of Doctrine Division, U.S. Army Engineer School; brigade observer-controller, Hohenfels, Germany; commander, A Company, 10th Engineer Battalion, Schweinfurt Germany; executive officer and platoon leader, 41st Engineer Battalion, Fort Drum, New York. He holds a bachelor's degree in mathematics from West Virginia State College.

Captain Baker is the operations officer, 2d Training Support Battalion (Engineer), 15th Support Brigade, Fort Meade, Maryland. Previous assignments include: commander, E/1-28 Infantry, Fort Jackson, South Carolina; commander, A/3-13 Fort Jackson, South Carolina; executive officer and platoon leader, 54th Engineer Battalion, Wildflecken Germany. He holds a bachelor's degree in civil engineering from the U.S. Military Academy.

Captain Staton is the Assistant S3, Plans Section, 479th Field Artillery Brigade, Fort Sill, Oklahoma. He was previously the engineer advisor, U.S. Army Readiness Group, Fort Sill. Other assignments include commander, 47th Engineer Company (C)(H), Special Troops Battalion, Fort Wainwright, Alaska; and A/S3 Construction, 555th Combat Engineer Group, Fort Lewis, Washington. CPT Staton holds a bachelor's degree in chemical and petroleum refining engineering from the Colorado School of Mines.

Improving Command and Control Procedures on Multinational Base Camps

By Major Karlus L. Cozart

When unexploded ordnance (UXO) were discovered within the confines of the base camp occupied by the Multinational Division (North) (MND(N)) of the Stabilization Force (SFOR) in Bosnia, commanders and staffs realized they needed to revise existing annexes to the base emergency-reaction plan. In some cases, they had to develop new annexes. This article describes significant command and control (C2) lessons that commanders and staffs assigned to the MND(N) learned as a result of this force-protection-related incident.

Organization

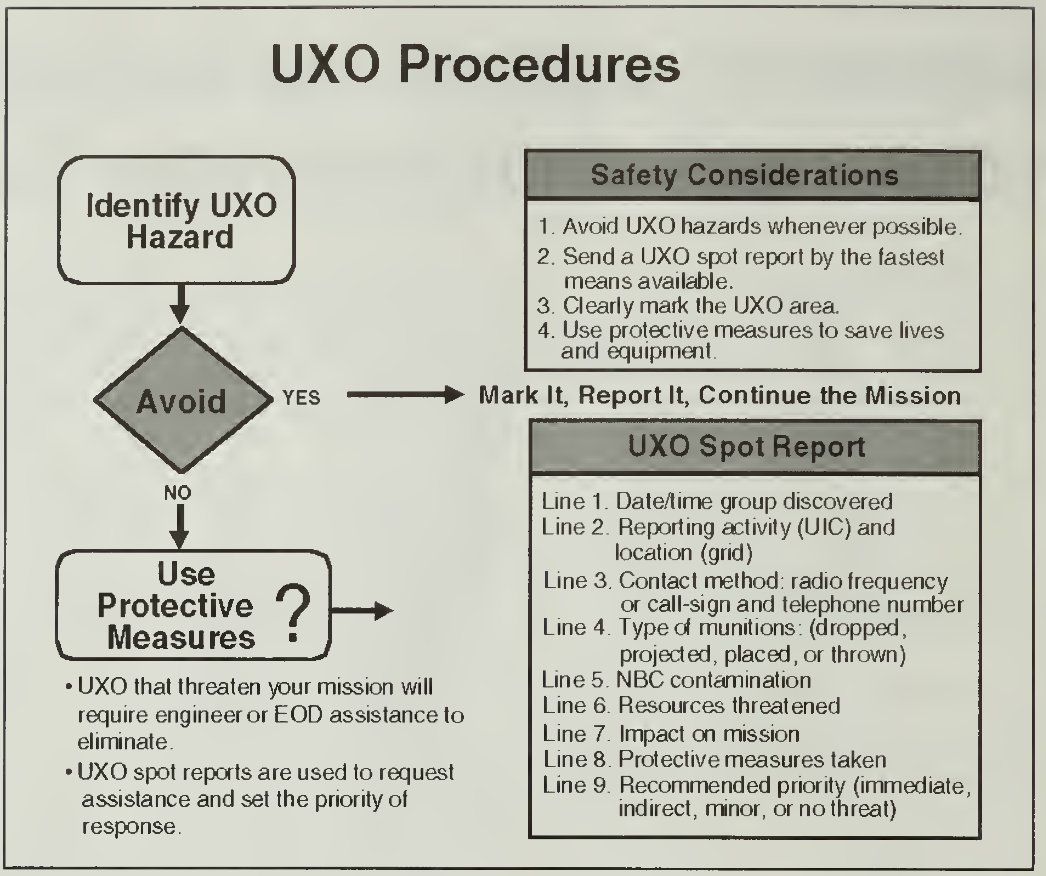
One unique aspect of MND(N) is its task organization. It is a division-level, multinational "combined-forces" task force (TF) made up of military and civilian personnel from both NATO and non-NATO countries. TF Eagle's command structure is a skeleton division headquarters staff. The forward division staff consists of a U.S. brigade combat team (BCT), three organic maneuver battalions, elements from the U.S. division's support command, and liaison officers from sister services and a dozen other nations. The BCT and two of the three battalion task forces simultaneously execute split-based C2 operations. For example, BCT staff sections execute dual functions as the division-and brigade-level staffs, while battalion task forces execute duties associated with operating two separate base camps.

Command and Control

Commanders of units deployed to Bosnia and Herzegovina to support Operations Joint Endeavor and Joint Guard exercise authority and direction, referred to as C2, over multinational and U.S. forces. Commanders perform C2 activities through an arrangement of personnel, equipment, facilities, and communication processes. A thorough understanding of established C2 procedures is essential for military units to accomplish missions successfully, especially during major campaigns and operations, such as Joint Endeavor and Joint Guard.

Army doctrine refers to the C2 function as "battle command," which is the art and science of battlefield decision making, troop leading, and motivating soldiers and organizations to accomplish missions at the least cost. According to Field Manual 100-5, *Operations* (the Army's doctrine on battle-command functions), "To command is to direct, and this process contains two vital components—decision making and leadership; control is inherent in battle command." Control monitors the status of organizational effectiveness, identifies deviations from set standards, and corrects them. Control serves its purpose if it allows commanders freedom to operate, delegate authority, lead from any critical point on the battlefield, and synchronize actions across the entire area of operations.

A soldier from the EOD Detachment prepares to destroy the UXO with blocks of C4 explosives.



UXO Procedures

Identify UXO Hazard
Avoid
YES
NO
Use Protective Measures ?
Mark It, Report It, Continue the Mission

Safety Considerations

1. Avoid UXO hazards whenever possible.
2. Send a UXO spot report by the fastest means available.
3. Clearly mark the UXO area.
4. Use protective measures to save lives and equipment.

UXO Spot Report

Line 1. Date/time group discovered
Line 2. Reporting activity (UIC) and location (grid)
Line 3. Contact method: radio frequency or call-sign and telephone number
Line 4. Type of munitions: (dropped, projected, placed, or thrown)
Line 5. NBC contamination
Line 6. Resources threatened
Line 7. Impact on mission
Line 8. Protective measures taken
Line 9. Recommended priority (immediate, indirect, minor, or no threat)

- UXO that threaten your mission will require engineer or EOD assistance to eliminate.
- UXO spot reports are used to request assistance and set the priority of response.

The MND(N) commander, referred to as COMEAGLE, was responsible for more than 42,000 DoD military and civilian personnel and their family members in the Central and Southern European Regions. COMEAGLE used several methods to determine where to strategically locate commanders throughout the battlespace. He moved them to specific areas when necessary but also employed modern technology, such as video teleconferences, when a commander's presence was required at several locations simultaneously. COMEAGLE's leadership in these situations placed commanders where they had the greatest C2 impact over the 13,000 deployed U.S. military personnel.

During Operation Joint Guard, TF Eagle's force structure was smaller than its Operation Joint Endeavor predecessor. Nevertheless, TF Eagle commanders clearly exceeded the doctrinal definition of what a U.S. division is expected to successfully command and control.

UXO Alert

Early one afternoon, personnel throughout the task force base camp were notified that UXO had been found within the confines of the base camp and that Air Force Explosives Ordnance Detachment (EOD) personnel would soon destroy them.

Alert notification personnel instructed that facilities located near the suspected UXO be evacuated. They also advised that office doors and windows throughout the base camp be opened to reduce possible injuries from flying glass when the UXO were detonated. Task force personnel implemented instructions provided as part of the alert notification process but suspected that the following information would have improved their situational awareness:

☐ What C2 structure is in place to respond to the incident?

☐ Where are the UXO located?

☐ When and where will the UXO be destroyed?

Some of the personnel conducting the notification were unable to answer these questions. Other C2-related questions asked before the UXO were destroyed revealed that individuals participating in the notification process also had different perceptions concerning the type of UXO found. For example, some military police advised that three 500-pound antitank bombs were found near one of the tent cities. Several other personnel tasked to direct or assist with evacuation of the tent cities had very little situational awareness. After being evacuated, some personnel within the safe-blast radius of the UXO stated that they did not know where the UXO were located. The location of UXO would have been critical had large munitions or scatterable mines been nearby.

New Annexes

Although the UXO were destroyed safely, the task force's command element discovered that the current execution checklist, standing operating procedure (SOP), and base emergency-reaction plans did not establish actions, responsibilities, or authorities needed for this situation. We concluded that revised annexes should address actions, authorities, and responsibilities during the following types of emergency situations:

- Reaction to UXO that present an immediate threat to base camp personnel.
- Base camp security when reacting to interior or exterior perimeter threats.
- Employment of quick reactionary forces in case of terrorist actions, hostage situations, and civil disturbances.
- Reactions to potential threats from natural disasters; bombs threats; and ground, air, and sniper attacks.
- Maintenance of base camp law and order through establishment of access control points, detainee processing measures, pedestrian and vehicle traffic-control routes, and facility security and emergency-evacuation plans.
- Siren notification drills.

Lessons Learned

Discovery of UXO on the MND(N) base camp taught commanders and staff that units must—

- Develop, consolidate, or update base emergency-reaction plans, SOPs, or execution checklists when occupying new base camps or areas of operation.
- Rehearse and update procedures for various force-protection situations.
- Establish and distribute policy regarding penalties for unauthorized personnel found in restricted areas or vehicles or caught tampering with sensitive equipment.

When developing emergency-reaction plans or during a UXO alert notification, commanders must—

- Rehearse established tactics, techniques, and procedures (TTPs) during hours of darkness and adverse weather conditions.
- Determine the UXO safe-blast radius and the location of rally points for personnel evacuated from facilities.
- Determine where evacuated personnel (military, civilians, and noncombatants) are to assemble (in predesignated bunkers or basements or remain in current facilities).
- Determine the appropriate uniform (modified battle dress, physical training uniforms, or the first thing each person can grab) for personnel who must evacuate various types of facilities (offices, aid stations, sleep tents, motor pools, dining facilities, recreation fields, etc).
- Prepare a list of personnel authorized to enter certain C2 facilities (the White House, Provost Marshal Office, or battle-update briefing tent) before completing emergency-reaction missions.
- Ensure that all personnel (military, civilian, and allies) and sensitive items are accounted for before and after UXO are destroyed.
- Determine who has release authority and who decides when it is safe to set off a high-order detonation.
- Know how many detonations are scheduled as part of the actual destruction process to ensure that personnel are not prematurely released into previously evacuated or restricted areas.
- Develop and rehearse joint service and combined forces battle drills, TTPs, or emergency-response plans (Army, Air Force, Navy, Marines, and multinational).
- Distribute compatible joint service and multilingual communications equipment (flags, radios, bull horns) that all parties/personnel can use.
- Update and distribute essential personnel notification rosters (for example, C2 structure, mayor's cell, EOD, military police, security police, engineers, fire department, medics, tactical operations center, quick reaction force, VIPs, liaison officers, etc).
- Develop clearing instructions for quarantine/road blocks and facilities (entry control points, engineer tape, or brightly colored area tape to close restricted areas).

DTLOMS Implications

These lessons learned have a training implication. Deployed units must have processes in place to ensure that all personnel, especially newly arriving personnel, are familiar with actions to be taken during various emergency situations.

Major Cozart is an operational level movement and maneuver observer/trainer and engineer SME with the Battle Command Training Program, Operations Group-Delta, at Fort Leavenworth, Kansas. In 16 years of service, he has completed five overseas assignments in various command, staff, and USACE positions (in Korea, Germany, Turkey, and Honduras). MAJ Cozart was brigade executive officer for the 1st Engineer Brigade, Fort Leonard Wood, Missouri. During Operation Joint Guard, he was attached to HQ-1st Infantry Division (Fwd) in Tuzla, Bosnia, as a command and control observer and team chief for the Center for Army Lessons Learned CAAT-IX.

Drilling Wells in the Tuzla Valley of Bosnia–Herzegovina

By Major Frank Akins

Diverse missions make peacekeeping operations challenging and interesting. During the summer of 1997, the primary well for Task Force Eagle's headquarters could not produce enough water for the population. The Base Camp Coordinating Agency (BCCA) initiated procedures to locate a water-well-drilling company. Geotehnica, a local company in the Balkans, was selected for the job. The BCCA engineers expected the well to be drilled at the speed of many American well-drilling outfits, but this was not the case. These well drillers were also working on other jobs, plus their older equipment required frequent maintenance. As a result, the job took 2 1/2 months instead of the expected seven days.

Progress, however, was made in due time… Geotehnica had technical expertise and knew where to find acquifers within Tuzla Valley and at what depth. The company drilled a test well and found viable quantities of water in a gravel acquifer about 87 meters (285 feet) below the surface.To find it, they drilled through about 80 meters (262 feet) of "tight" clay (Figures 1 and 2). The first well drilled at that location caved in. A second well was successfully drilled near the first one by using high proportions of bentonite drilling mud in the drilling fluid to keep the hole open.

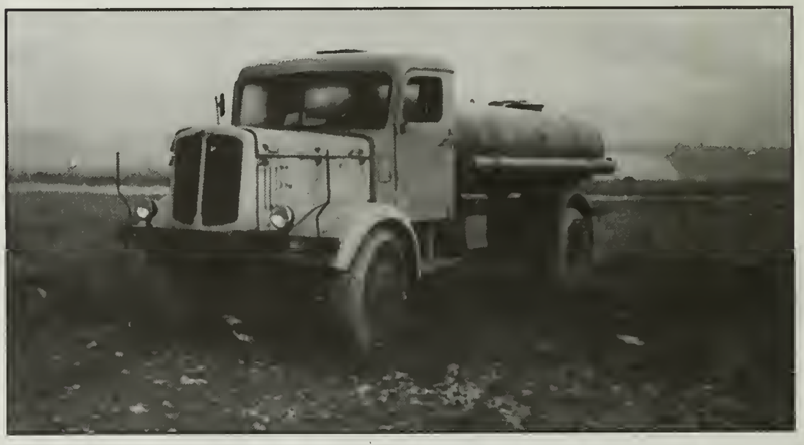


Figure 1. This Soviet-designed water truck transports water used in drilling mud for boring the test well and the main well.

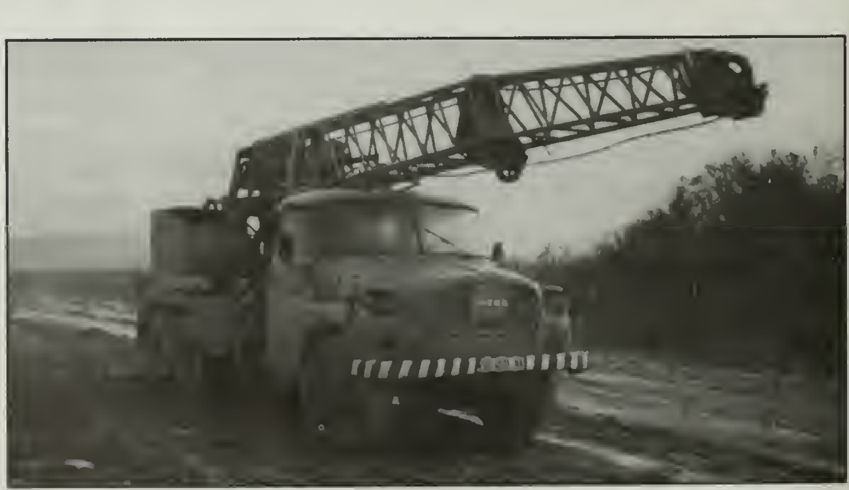


Figure 2. This truck-mounted drill rig of Soviet design is used to bore the test well.

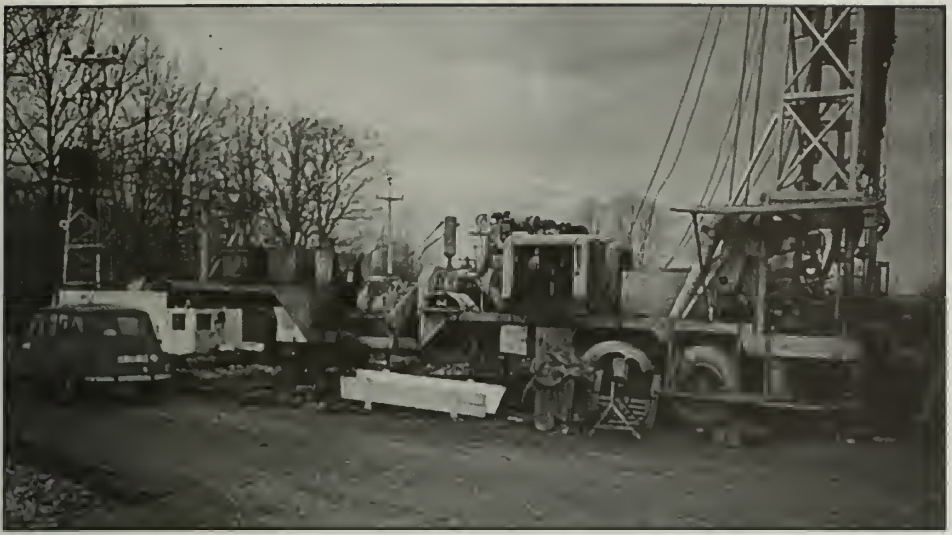


Figure 3. The primary drill rig at Task Force Eagle uses two Detroit Diesel V-8 engines. The mast is about 35 feet tall.

The bentonite caked on gravel in the acquifer and plugged the flow of water.

After the drill crew spent about 30 days purging the well with clean water, the sustained rate of flow was 5.8 liters per second (lps) (91.9 gallons per minute [gpm]) with a temporary "peak flow" capability of 10 lps (158.5 gpm) production for 6 hours. At that point, the amount of water withdrawn resumed at 5.8 lps. When operated in this manner, the well exceeded the additional required water flow per day for Task Force Eagle headquarters.

Task Force Eagle engineers were concerned that the locally contracted company took so long to drill the well. However, the work was satisfactory and a viable well was safely dug without mishap. CPT Derrick Wasson, an industrial engineer assigned to the BCCA, was the military engineer on site for liaison purposes and quality control. Using an old copy of *The Missouri Water Well Handbook,* he ensured that the well was installed correctly. Well-drilling procedures in the Balkans are similar to those used in the United States, including the rigs and operator tasks. The rig was produced in the United States, and the drill stem (pipe) was the same dimensions as those used in the United States (see Figure 3).

The well's acquifer is protected by fine, tight clay, and the well was installed to standard. It should provide adequate water for personnel at the Task Force Eagle base camp for many years.

Major Akins is a writer for the Center for Army Lessons Learned at Fort Leavenworth, Kansas. Previous assignments include Weapons Effects Research Geologist for the Corps of Engineers, Vicksburg, Mississippi; Demolitions Chief, Fort Leonard Wood, Missouri; and company commander, 62d Engineer Battalion (Cbt Hvy) Fort Hood, Texas.

PERSCOM Notes

By Sergeant Major Jay Florance

Hello from PERSCOM! As the sergeant major for the Engineer Branch, I am responsible for the assignment of all engineer soldiers in career management fields (CMFs) 12, 51, and 81 in the grades of first sergeant and below. During the year that I have been in PERSCOM, I have seen many changes and reductions in force structure that directly impact the availability of assignments in the engineer community. The following information is provided to assist soldiers in their career development.

Much turbulence has occurred in the first sergeant/master sergeant arena. When battalions assign a master sergeant to a first sergeant position, they frequently fail to submit the request required to "stabilize" the soldier (retain him/her in the current duty position). The proper tool to stabilize soldiers is DA Form 4187 (Personnel Action). When PERSCOM does not receive this form, we assume the soldier is available for assignment and may prepare permanent change of station (PCS) orders to fill a required position. This situation occurs frequently and causes much confusion that impacts other soldiers. Many of the positions PERSCOM fills at the master sergeant level require that the soldier arrive at the duty station by a specific date. When we cannot move a soldier who is stabilized in a position, the replacement soldier receives very short PCS notice.

Assignment of a master sergeant to a first sergeant position is an investment in which the Army and the individual share joint responsibility. If the soldier is not properly stabilized in the position, he/she will not remain in this critical career position long enough to ensure proper career progression.

The Engineer Branch must use its limited resources to best advantage. Open and frank communication between units and PERSCOM is necessary to make this happen. The following actions will protect your unit's investment in first sergeants:

- ❒ Ensure the S1 calls PERSCOM at (703) 325-4825 or DSN 221-4825 when the commander decides to place a master sergeant in a first sergeant position. We will then agree on the best course of action for the soldier.
- ❒ Ensure your first sergeants are stabilized. Your Personnel Action Center can check the Assignment Eligibility and Availability (AEA) code listed in the Standard Installation/Division Personnel System (SIDPERS). If stabilization is finalized, the AEA code will be a "G" followed by the month and year stabilization ends. If this code is missing, your first sergeants are not protected!

Some installations lack available master sergeants to fill first sergeant positions and may fill them with sergeants first class. If that situation occurs, call us before placing a noncommissioned officer in the first sergeant position. We will do what we can to protect the soldier and your assets.

The Engineer Branch Chief, LTC Tillotson, has sent an e-mail message to most battalion commanders requesting help in this crucial area. We stand committed to take care of the engineer force.

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Department of Training and Doctrine Development (DOTD)

Army Values. Beginning with this issue of Engineer, we will feature the seven Army values on the back cover. The April issue defines and displays "Loyalty." Future magazines will illustrate Duty, Respect, Selfless Service, Honor, Integrity, and Personal Courage. Together these words spell the acronym "LDRSHIP." Soldiers and civilians are encouraged to read and reflect on these ideas. POC is Larry Roberts, -6109.

Field Manual Update. FM 5-116, Engineer Operations: Echelons Above Corps, provides doctrine to commanders and staffs concerning the employment of engineer units at echelons above corps (EAC). These units construct, maintain, and rehabilitate the logistical infrastructure needed for operational sustainment of combat forces. The revised manual is tentatively scheduled for completion in July 1998. POC is Sandra Gibson, -4115.

Staffing of Draft Publications. Draft copies of FM 20-400, Military Environmental Protection, and TC 20-401, The Soldier and the Environment, are currently posted to the Engineer School's Publications Page (http://www.wood.army.mil/PUBS/pubs.htm) with a suspense date for changes of 17 April 1998. When published, FM 20-400 will supersede TC 5-400. POC is Bob Layman, -4131.

Engineer Unit Directory. The 1998 Engineer Unit Directory may be viewed on the Internet at http://www.wood.army.mil/DDD/ddd.htm. Access requires Adobe Acrobat Reader. The directory is updated periodically, and units may submit changes at any time via e-mail to: bakern.wood.army.mil. POC is Nancy Baker, -4100.

Engineer Personnel Proponency Office (EPPO)

DA Pam 600-3, Commissioned Officer Development and Career Management. The Engineer Branch's input to the revised DA Pam 600-3 was submitted in February. The revised chapter describes engineer officer development and career management under Officer Personnel Management System XXI. It may be viewed on the Fort Leonard Wood homepage (www.wood.army.mil/EPPO/eppo-hp.htm). Distribution of the revised DA Pam is scheduled for November 1998. POC is MAJ Dave Hartley, -4087.

Accession Board for Military Occupational Specialty (MOS) 215D, Terrain Analysis Technician. There is a shortage of personnel applying for MOS 215D. The Recruiting Command will conduct a warrant officer accession board in late May 1998 to access noncommissioned officers and soldiers in the rank of sergeant (P) or higher. Prerequisites are: a minimum of four years' experience as a terrain analyst in MOS 81T (old 81Q), one year's experience at the division level, and two years' experience in a position supervising terrain analysis activities. The e-mail address for additional information and application procedures is: tresslef@wood.army.mil POC is CW4 Fred Tressler, -4088.

Lead the Way

By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School

Enlisted Engineer Personnel Issues

In visits to engineer units, I find that enlisted personnel issues are a major concern for first sergeants and command sergeants major. This probably is because most of us don't understand the total picture when it comes to enlisted personnel issues.

The Engineer Corps is addressing this problem in several ways. First, we are doing everything we can to keep senior engineer noncommissioned officers (NCOs) informed about enlisted personnel issues. Beginning in this issue of *Engineer*, the PERSCOM Engineer Branch Sergeant Major, SGM Florance, will include information in the "PERSCOM Notes" (page 47). In it he will discuss enlisted engineer personnel issues and provide manning guidance and insight into current personnel trends affecting soldiers.

The staff at PERSCOM works very hard to honor requests for assignments when they can and still meet the Army's needs. They cannot meet every soldier's personal request for assignment. Prior planning, proper coordination, and properly completed paperwork will help ensure that a soldier's request for a particular assignment is granted. Soldiers should be aware that, when they decide to purchase a house near a particular installation or when their spouse makes an employment decision at a particular installation, their decision may conflict with the Army's needs. There are no guarantees that any soldier will ever return to a particular installation. Engineer leaders must keep soldiers and their families properly informed and be candid with them before major decisions are made to purchase a home or have their spouse commit to long-term employment opportunities.

Second, the Libby Noncommissioned Officers Academy, the Engineer Personnel Proponency Office at Fort Leonard Wood, and the PERSCOM Enlisted Engineer Branch are working to prepare a video tape that will explain enlisted personnel issues. Designed for young soldiers and NCOs, the video tape will be available to all engineer units.

Last, but certainly not least, we will discuss enlisted engineer personnel issues during the Council of Command Sergeants Major/Sergeants Major, which will be held during the ENFORCE XXI-98 in April. The U.S. Army Director of Enlisted Personnel, BG McWilliams, will address council members, and we will conduct a video-teleconference to discuss changes in personnel strengths in all engineer military occupational specialties.

To properly manage the engineer force takes a team effort. Your suggestions on ways to improve our corps are welcome.

Safety

The Army recently identified two major problems concerning off-duty safety: accidents involving privately owned vehicles and suicides. We must keep our soldiers informed and ensure they have proper safety habits and act responsibly. Our NCOs at the first-line supervisor level are key to making this happen. As senior leaders, we must give our NCOs the tools, training, and support they need to do their jobs properly.

Our soldiers and their families are our most precious resource. We must do everything possible to keep them safe and to help them learn about safety issues. Every unit needs a safety council to plan and resolve safety issues. Engineer units should hold safety briefings and inspections regularly. Risk management and risk-assessment procedures must be ingrained in every leader and part of every mission. Nothing is more important than safety. It helps us preserve our most precious resource, our soldiers and their families.

The Army Engineer Association is *our* Army Engineer Association. It deserves your support.

☆ U.S. GOVERNMENT PRINTING OFFICE 1998: 655-120 / 80002

ARMY VALUES

LOYALTY:

Bear true faith and allegiance to the U.S. Constitution, the Army, your unit, and other soldiers

"My first wish would be that my military family, and the whole army, should consider themselves as a band of brothers, willing and ready to die for each other."
General George Washington, 1798

Sergeant George D. Libby

Company C, 3rd Engineer Combat Battalion,
Medal of Honor

In the face of the massive North Korean assault in the summer of 1950, American forces began withdrawing to southern South Korea. In one instance an American vehicle encountered intense fire at an enemy roadblock. Sergeant Libby returned the fire and rendered aid to those wounded in the encounter. After loading the wounded onto another vehicle, Sergeant Libby shielded the driver of that vehicle with his own body while returning fire. Although wounded several times, Sergeant Libby helped load other wounded soldiers aboard the vehicle during the withdrawal. He continued to shield the driver until he lost consciousness. Sergeant Libby subsequently died of his wounds.

History Office, U.S. Army Engineer School

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July 1998

Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

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UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

RAIL REPAIR IN BOSNIA

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CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

ENFORCE was a great success this year, with the Engineer Tattoo being one of the most memorable highlights in an event-filled week. I want to thank everyone for their long hours and hard work and for paying attention to the small details to ensure everything went smoothly. I am proud that Fort Leonard Wood was able again to shine and demonstrate that it is one of the Army's premier installations. (See article, page 13.) A job well done by all.

During his speech at ENFORCE, LTG Ballard announced the new regimental vision encompassing the entire corps and stressed the importance of everyone participating in the process to develop a truly comprehensive vision. I echo our chief's comments and expect everyone to get involved: read the vision, think about it, and provide feedback. The future of our Corps and its mission in service to the nation lie in the balance. So, take the time and become part of the future. The easiest way to do this is from the USAEC home page at www.wood.army.mil. Use the hotlink and go directly to the regimental vision to read and comment about the work to date. The candidate vision statement is:

The Engineer Regiment:

- **The World's premier engineering organization**

Our vision must encompass all members of the regiment (active and reserve, officer and enlisted, DA civilian and contractor, associations and retirees).

- **Full-spectrum engineer force**

We must be capable of meeting future engineering tasks across all conditions of peacetime and wartime.

- **Vital member of Army and Joint Teams**

The regiment is successful only if those we support recognize that we are integral to their mission success.

- **Values-based, respected, responsive, reliable**

In all we do, we must embody Army values and the Essayons spirit.

- **Meeting tomorrow's challenges—relevant to our National Military Strategy**

Throughout our history Army engineers have responded to the changing needs of the nation. We must continue this proud heritage by ensuring our regiment is fully engaged in proactively changing for the future.

Next, I invite you all to a conference this fall that will be just as rewarding as ENFORCE. A mine warfare symposium sponsored by the Association of the United States Army (AUSA) will be held at Southwest Missouri State University [SMSU] in Springfield and at Fort Leonard Wood. The purpose of the conference is twofold: to showcase how the United States is leading the international effort to demine the world; and then, after an introduction to our current mine doctrine, to conduct a live-fire demonstration of two self-destructing [SD] mine systems. Final dates and details will follow.

The first day, at SMSU, will include a series of lectures and displays. Presentations will cover the spectrum of the entire landmine debate, from official policy and training of deminers to treating and rehabilitating mine victims. The capstone for the day will be a mediated panel discussion representing all views on the use and utility of mines today and in the future. Topics to be debated will include the defense of our ally, the Republic of Korea; the responsible use and need of tactical SD mine systems; and feasible courses of action to eliminate the suffering caused by mines already in the ground. In preparation, I recommend reading an excellent article from the May 1998 issue of *Proceedings* titled "Landmines, Lies and Other Phenomena," by MG [R] J. D. Lynch, U.S. Marine Corps.

The next day, at Fort Leonard Wood, will center on the live fire of two SD mine systems, the Volcano and the Modular Pack Mine System (MOPMS). Following an introduction to their current tactical uses, both will be deployed. After the mine systems self-destruct, refreshments will be served downrange to clearly demonstrate the weapons' reliability. This is a unique training opportunity to see firsthand weapon systems used exclusively in tactical situations in high-intensity conflicts. We have already received inquiries from combat leaders who wish to see this demonstration, and I hope to also see many from the Engineer Regiment.

I have been your commandant for the last year and every day just gets better. From our dedicated civilian work force to the high quality of new soldiers entering the Army here, I am very impressed and pleased. Whether active, reserve, national guard, civilian, or retired, we have the best personnel here at Fort Leonard Wood.

Engineer

uly 1998 Headquarters, Department of the Army **Volume 28 PB 5-98-3**

**UNITED STATES ARMY
ENGINEER CENTER AND
FORT LEONARD WOOD**

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04795

Front Cover: *Destroyed railroad bridge at Brcko, Bosnia (see article on page 2.)*

Back Cover: *A historical example of the Army value "Duty."*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 370, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 370, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER's e-mail address is: eubanksc@wood.army.mil. Our Internet home page s located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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NATO Rail Operations in the Balkans

By Lieutenant Colonel Christopher J. Toomey

The railroad bridge at Brcko was reconstructed by USAID in 1997.

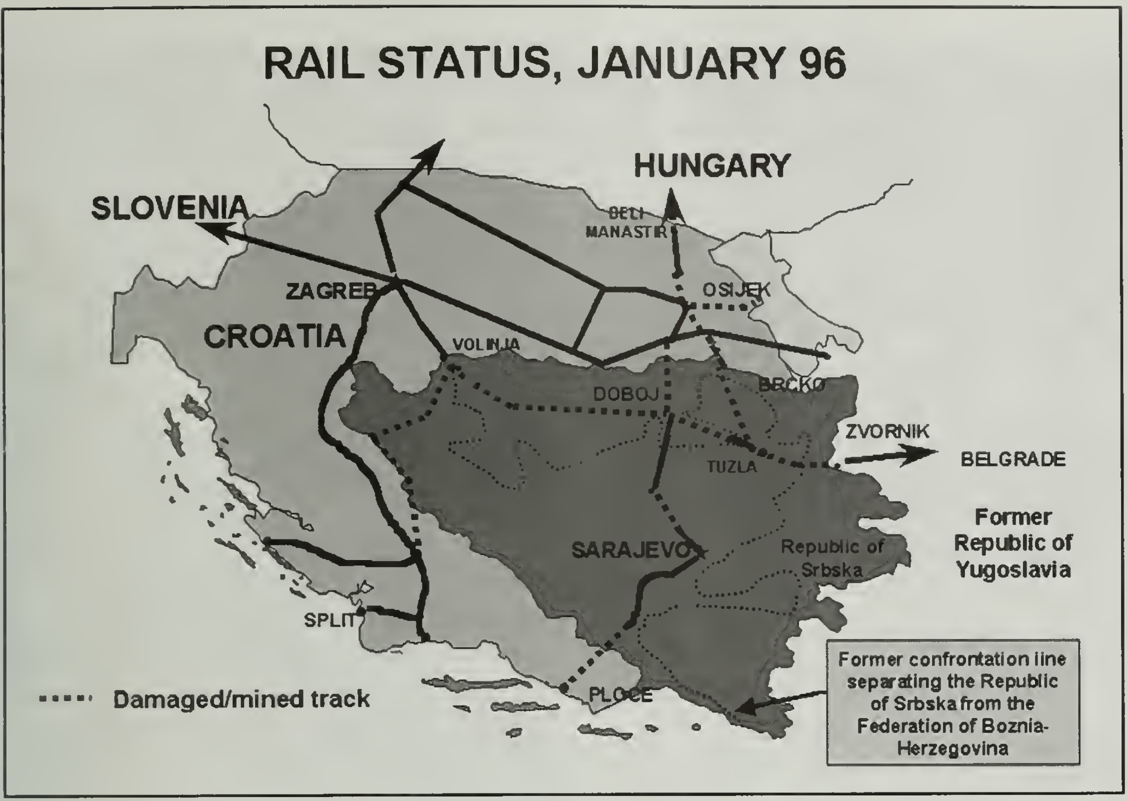
> *"We will take measures to repair and improve the road and rail infrastructure of the area in order to facilitate movements from east to west and north to south."*
>
> *Carl Bildt*
> *U.N. High Representative*
> *14 February 1997*

When the NATO Implementation Force (IFOR) deployed to Bosnia in 1996 to enforce the military provisions of the Dayton Accords and ensure peace and stability, it found a rail system in total disarray. The devastating civil war from 1990 to 1994 resulted in serious damage to the rail systems in both Bosnia and Croatia: lines were torn apart, blown up, or mined. Embankments were used as field fortifications and became inundated with bunkers. Wooden sleepers (pieces of timber used to keep steel rails in place) were burned for fuel or used in construction, as were tons of ballast. Bridges were destroyed and approaches mined. Telecommunications systems, rail stations, and rolling stock—the trains—became casualties of the conflict. More than 75 percent of the locomotives in the region were destroyed, and the traffic loss was immense. In 1996, passenger rail traffic was estimated at 10 percent of the 1989 level, and freight traffic was at 15 percent of the prewar level.

This article examines the efforts by both IFOR and Stabilization Force (SFOR) engineers, working in conjunction with the international community, to rejuvenate the Balkan rail system. The primary office responsible for theater-level engineer planning, the Combined Joint Engineer (CJENGR), is headquartered in Sarajevo.

To influence the rebuilding of the rail system, CJENGR accepted four major tasks:

- Serve as technical advisor to the command and civilian organizations.
- Develop policies and implement programs to translate the commander's intent into concrete action.
- Unify the various IFOR/SFOR agencies that touched rail operations, including the civil affairs and information campaigns.



- Synchronize SFOR actions with various civilian initiatives to ensure maximum use of resources.

1996 Initiatives

From the outset of its involvement in Bosnia, NATO's military planners and engineers were concerned with reestablishing an effective rail system. In a country with a very limited road network, a functioning rail line is an asset to any military force concerned with supplying and reinforcing its forces.

Initially, only IFOR had the resources, the manpower, and an organization available to make immediate and noticeable rail improvements. They focused on developing the rail network to link and support NATO's Multinational Divisions. Since the cost to repair severely damaged rail bridges along the Sava River was estimated at several million dollars, IFOR decided to avoid the north-south line and concentrate on opening the east-west line from Volinja through Doboj and on to Zvornik (see map). In all, NATO repaired or funded the rejuvenation of 460 kilometers of track at a cost of $5.6 million. The project consumed more than 1,000 tons of rail and included extensive demining and the repair of three major bridges.

The project was an outstanding example of multinational military cooperation, with German, Italian, Hungarian, Romanian, and U.S. engineer units working together along various sections of the line. The bulk of the work was executed by the Italian Railway Engineer Regiment, which also maintained overall technical supervision.

Several international organizations, working in coordination with NATO, initiated repair efforts during 1996. Three groups in particular—the International Management Group (IMG), the World Bank, and the U.S. Agency for International Development (USAID)—became key players in focusing money and resources on rail reconstruction in the region.

1997 SFOR Initiatives

Realizing the enormous economic potential that a fully rejuvenated rail system means to Bosnia, SFOR became involved in developing the system above and beyond direct support to NATO forces. Reestablishing an effective rail link between Bosnia and Europe will help promote regional stability, a major component of SFOR's mission.

Obstacles

Despite IFOR's efforts, there was still significant damage to the rail system at the beginning of 1997. The IMG repaired electrical and communication lines between Sarajevo and Ploce in 1996, but electrification and signaling remained major shortfalls.

Political problems complicate the situation. Three rail companies operate in the region, each aligned with a particular ethnic faction: Croatian Rail, Rail Company of the Republic of Srbska, and Rail of the Federation of Bosnia-Herzegovina (ZBH). With no central governing body, there is constant discourse on priorities and resourcing. Each company is fiercely territorial and consistently considers its portion of the line in isolation rather than as part of a network.

It is seemingly impossible to prevent political agendas from influencing activity along the rail lines. SFOR's freedom of movement along the lines is assured by the Dayton Accords, but in early 1997 physical damage and political impasse prevented restoration of regular traffic.

Developing Priorities

In establishing SFOR's priorities, CJENGR worked closely with SFOR civil affairs experts, the Civil Military Commission (CIMIC), to form the Theater Rail Working Group. This group periodically brought together SFOR and external agencies—IMG, USAID, and the World Bank—with a rail interest in Bosnia. The working group established the following priorities for 1997, with the overall aim of creating a link between Bosnia and the rest of Europe:

- Complete repairs to the east-west line.
- Improve signaling at Doboj Junction.
- Facilitate repairs between Tuzla and Brcko.
- Facilitate linking Brcko through Croatia into Hungary.

SFOR's priorities were synchronized with the IMG's plan to concentrate on upgrading the line between Ploce and Doboj while USAID constructed the rail/highway bridge over the Sava River at Brcko.

East-West Line. Funds from the 1996 project were used to resume repair on the east-west line in April 1997. The upgrade involved repairs between Banja Luka and Doboj and cost almost $5 million. Work contracted through the Rail Company of the Republic of Srpska included repair or replacement of ballast, sleepers, rails, switches, and rudimentary signaling at various sections along the line. Many small bridges were upgraded, and some areas were demined to permit reconstruction. NATO furnished much of the material and pushed initiatives to make local military personnel participate in demining. As in 1996, the Italian Railway Engineer Regiment maintained overall technical supervision of the repairs. Work on this line was completed in October 1997.

Doboj Junction. A major rail junction in Bosnia, Doboj Junction lies within the zone of separation between the Republic of Srbska and the Federation. The junction is important both technically and politically, because it is an area in which the two factions in Bosnia must come together to resolve differences.

Several months of discussion resulted in a decision by NATO to invest almost $500,000 to increase the junction's throughput capacity to 60 trains a day. This ensures that SFOR trains can travel uninterrupted for the foreseeable future. Improvements to Doboj Junction have definite civil benefits because the station links the important industrial areas of Tuzla and Zenica with the rest of Bosnia. Contractors completed the following work by November 1997:

- Improved the road network and buildings in and around the junction.
- Completed communication links between dispatchers in the station and along the line, switch operators, and operators in the locomotive depot and marshalling yards.
- Repaired automatic telephone networks.

Tuzla-Brcko-Hungary Line. Traditionally, the mineral-rich Tuzla Valley was a key economic area with a strong industrial base. Before the war and the destruction of connecting rail lines, goods and minerals were shipped by rail to the Sava River port of Brcko or to ports along the Danube. As 1996 ended, industrial output in the region was estimated at 15 percent of prewar levels, while unemployment was at 70 percent. SFOR and U.N. economic analysts projected that reopening full rail traffic would immediately bring nearly $20 million to the region and employ 1,200 people, with a potential for 56,000 jobs in the Brcko-Zenica industrial region.

Politically the area is troubled. Brcko, claimed by both Serbs and Muslims, is still a divided city patrolled by U.S. forces from Multinational Division (North). The potential for economic growth that a healthy rail line brings will help reduce political and ethnic tension.

In Croatia, the line enters another contentious area—Eastern Slovenia—which was governed by the U.N. Transitional Authority for Eastern Slovenia until late 1997. Conditions there were economically grim with un-employment at 60 percent. Completing the railroad enables access to the Danube River ports, connection to the European line in Hungary, and the potential for significant economic improvements.

Developing a Strategy

The SFOR effort was led by the CJENGR with heavy support from the CIMIC Task Force. These two organizations formed a "rail team" that attacked rail issues and worked as partners throughout the process. The team fully assessed the technical, political, and economic issues involved in re-vitalizing the rail system. Key components of the strategy follow:

Focus on the Permanent Railway. As with the 1996 effort, SFOR realized that it was initially important to make the track functional. Support for signaling and telecommunications will follow once the international community sees the tracks in use.

Work Closely With USAID-Bosnia. Since the earliest introduction of NATO forces, USAID resourced projects throughout the country. It rebuilt the rail and highway bridge

Photo courtesy of the 16th Engineer Battalion, 1st Armored Division.

The first train of U.S. equipment leaves the Bosnian military railhead at Lukavac on 21 April 1998.

across the Sava River at Brcko in anticipation that SFOR would rebuild the rail line between Tuzla and Brcko.

Use NATO Engineers When Available. Using SFOR or additional NATO forces to help construct all or part of the railway reduces the overall cost and makes projects more attractive to USAID and other civil organizations. The Italian Railway Engineer Regiment deployed to Bosnia in 1997. Other forces included the Romanian Engineer Battalion and Hungarian Engineer Contingent (a force larger than a battalion), which are directly under CJENGR's control as part of SFOR.

Open Negotiations in Croatia. Any work in Croatia requires the input of Croatian Rail and the Croatian Government, as well as civil organizations that act exclusively in Croatia.

Rebuilding Tuzla to Brcko

From the outset, USAID funded all material for repairing the line between Tuzla and Brcko but could not fund contract labor for the entire line. Deployment of the Italian Railway Engineer Regiment greatly reduced the overall repair costs. Italian engineers repaired more than 600 breaks in the line and replaced the main section between the Kalanac and Lipovac bridges. They were supported by the Hungarian Engineer Contingent, which executed numerous general engineering tasks, to include demining. Soldiers from the Army of the Republic of Srbska, who were trained under a U.S. Department of Defense-sponsored program, also performed demining.

USAID eventually contributed about $2 million, which provided material for the line; contract repair of bridges at Lipovac, Kalanac, and Spionica; repairs at a landslide at Tinja; and repair of the train station at Bukovac.

Rebuilding Brcko to Hungary

The map on page 3 shows that repairing the Tuzla to Brcko section was pointless without also repairing the line through Croatia into Hungary. However, the direct line to the north was heavily damaged in Croatia. A major technical obstacle was repair of the Basut River bridge and the 12 kilometers of track between the bridge and Vinkovci. Croatian Rail pledged to repair this section, including demining the line and the bridge, if USAID provided material assistance. USAID-Bosnia pledged the materials and committed $400,000 to repair the bridge. SFOR's office in Zagreb, in conjunction with USAID, provided project oversight and overall technical supervision. The project was completed in December 1997.

The line from Vinkovci to Osijek was entirely destroyed. Much of the 35-kilometer line was heavily mined and inaccessible. The estimate to restore the permanent railway is about $15 million, which makes it uneconomical to repair at this time. Instead, traffic was moved from Vinkovci to Vroplje and thence to Osijek, where the line was in good repair and required only additional switching and signaling to transfer the trains at Vroplje.

The last section, Osijek to Beli Manistar (along the Hungarian border), eventually required minimal SFOR input. Once Croatian Rail was convinced that the Brcko to Vinkovci section was a reality, they began to repair the Osijek-Beli Manistar line in a joint venture with Hungarian rail authorities. This effort included extensive contract and military demining.

Lessons Learned

Military engineers can gain much from CJENGR's experiences in developing the strategic rail plan.

Take a Team Approach. The success of SFOR's rail program is largely due to the positive interaction of the various elements of the command. Working as a team magnifies the expertise of individual components.

Look Beyond the Technical Issues. Most problems are complex and involve much more than surmounting technical obstacles. Engineers must become involved in addressing the often closely related political and economic issues. In many instances, CJENGR became involved in negotiations that required engineers to fully understand the economic and political issues at hand.

Work With Civil Agencies. An integral part of SFOR's efforts was to develop a positive relationship with interested civil agencies. This included understanding their objectives and concerns, as well as exhibiting the ability to compromise. Civil agencies do not necessarily have the same agenda as the military force and often have a different time line. Engineers must forge partnerships with civil agencies to tap into diverse resources and ensure a mesh between military and civilian planning.

Think Regionally. Infrastructure, particularly transportation networks, must be thought of regionally. Shifting political boundaries may not align with natural boundaries, which influences the development of road and rail networks. By developing a regional approach, military engineers can learn to appreciate the breadth of factors affecting issues.

Prognosis

Through the efforts of SFOR and partner civil agencies, the permanent railway is functioning along main sections of the line. NATO forces are using the rail system. In fact, much U.S. equipment moves over rebuilt sections of the rail line. Many countries that contribute forces to SFOR are expanding their use of rail in moving and supporting forces in the region. Rail is also used extensively in Croatia, with the Croatian government working to maximize the economic potential of a functioning rail system.

Civilian traffic within Bosnia is still minimal. Much of this is due to political complications. Perhaps the following 10 February 1998 statement from Radio Free Europe accurately sends the message:

> *Klein Urges Restoration of Bosnian Rail Traffic. Jacques Klein [deputy to the U.N. High Representative for Implementation of the Peace Agreement] said in Sarajevo on 7 February that the rail system presents "the worst case of all the public utilities [in Bosnia]. Almost no train is running..., [which] means waste on a large scale, because no train means no investment, no investment means no jobs."*

Although some technical obstacles exist, most of the issues that prevent regular traffic are political and involve reluctance by the various entities within Bosnia and Croatia to grant full access to cross-border traffic. Many people recognize the importance of rail for economic regeneration, but internal restrictions to free movement across borders keeps political leaders from allowing the rail system to realize its enormous potential.

Ultimate responsibility for successful rejuvenation of the rail system rests with the Bosnian and Croatian governments. They must show the good faith and willingness to support progress that will entice international investment on a large scale. Restrictions on movement will be the deciding point on the future of rail traffic—and the regeneration of the economy—in Bosnia.

Lieutenant Colonel Toomey, U.S. Army Corps of Engineers, is currently commanding the 14th Engineer Battalion at Fort Lewis, Washington. He was previously SFOR's Chief, Engineer Plans. LTC Toomey is a graduate of the U.S. Military Academy.

Planning Engineer Support for a MOUT Attack

By Captain John C. DeJarnette

Today's soldiers must be prepared to fight on increasingly diverse terrain, including terrain containing manmade features found in urban areas. These elements are viewed as obstacles of maneuver. Military operations on urbanized terrain (MOUT) encompass all military actions planned and conducted on a terrain complex where manmade construction impacts on the tactical options available to a commander.

This article provides considerations for engineer planners and leaders to employ when battalions and brigades seize built-up areas. It is intended to amplify current doctrine outlined in FM 90-10-1, *An Infantryman's Guide to Combat in Built-Up Areas* (with change 1). Lessons learned are drawn from observing attacks on the Shugart-Gordon MOUT training facility at the Joint Readiness Training Center.

Mission Analysis

Mission analysis sets the conditions for planning and ultimate success of MOUT operations. Engineer planners must identify specified, implied, and essential tasks as well as constraints and limitations. Well-prepared engineer battlefield assessments (EBA) and terrain analysis products are essential. Answering the following questions will help engineer planners develop an effective MOUT offensive mission analysis.

- ☐ **Where is the key/decisive terrain?** Identify this terrain for the approach march and for seizing buildings. Conduct a line-of-sight analysis along the route and compare it to the enemy template.
- ☐ **Where are the best reduction sites and support-by-fire positions for securing a foothold?** Consider the terrain, the enemy force template, and massing fires. Determine the minimum engineer force required to seize a foothold, seize essential facilities, and provide mobility support to mounted forces, such as how to sequence engineer tasks and change the engineer task organization to accomplish essential tasks. Identify the key leaders required to facilitate command and control of critical events and task organization changes.
- ☐ **How should subordinate units execute in-stride versus deliberate breaching operations based on the enemy template and results of reconnaissance and surveillance (R&S) efforts?** Decide where to use the mine-clearing line charge (MICLIC), tank-mounted countermine equipment, and manual breach techniques. Balance exposure of the breach force to enemy fires with the probability that a system may be killed before it can be employed.
- ☐ **How will reconnaissance forces link up, guide, or mark obstacles for bypass/breaching operations?**
- ☐ **What are the counterattack routes of the enemy force?** Consider the terrain and weather. Determine if enemy counterattack routes can be used to move friendly combat service support assets based on the enemy event template and time phasing of the counterattack. Determine what situational obstacles (rapid mining, scatterable mining) the enemy counterattack force has available.
- ☐ **What is the safety zone and trigger for using scatterable mines?** Ensure that this information is disseminated at all rehearsals.
- ☐ **What is the composition of the buildings to be attacked?** Determine the effects weapons will have on these structures (this drives the selection of fuze/shell combinations and aircraft attack munitions).
- ☐ **What is the "layout" of the town both above and below ground?** Determine the protected areas, such as churches, hospitals, and museums. Sources for this information are imagery from the division, gun camera tapes from OH-58/AH-64 helicopters, Michelin road maps, and tour books.

Support Products

The engineer staff planner helps when the following products are developed to support the military decision-making process (MDMP) after the initial warning order is received. These products are updated based on the results of reconnaissance and surveillance.

Engineer Battlefield Assessment

The EBA feeds many of the subsequent products. Clearly articulate the enemy engineer capability based on the most likely and most dangerous courses of action. Consider past experience with this enemy, his current strength, anticipated barrier material basic loads, expected resupply rates, and locally available materials the enemy can use to prepare his defense. This information will support development of the situation template (SITEMP).

Identify friendly engineer capabilities for mobility, countermobility, and survivability operations. Explicitly state the number and types of breaches each engineer unit is capable of executing based on its personnel, equipment, and logistical status. Leader proficiency and audacity impact on this estimate, so plan two levels down, based on the unit. Use this information to develop the task organization later in the MDMP.

Estimate the impact of terrain and weather on both friendly and enemy capabilities. Line-of-sight, hydrology, cross-country movement, and line-of-communication overlays are helpful and can be provided by the division terrain detachment or quickly approximated from maps.

SITEMP

Know the enemy capability based on an estimated unit basic load of Classes IV and V materials and anticipated resupply. The time available to prepare the defense is essential. Reconnaissance assets should observe the delivery and emplacement of barrier materials. Template enemy obstacles and counterattack routes based on terrain and weather conditions. Determine what resources are available in the MOUT area (ammonium nitrate, acetylene, propane, lumber yards, jersey barriers, vehicles, and construction equipment) that can contribute to his defensive preparation.

Based on this analysis, the engineer and S2 jointly template the enemy engineer countermobility/survivability capability on the SITEMP. It should include minefields, tactical and protective wire obstacles, and vehicles and other barriers in roads. This overlay is used to plan the engineer task organization, because this and the friendly scheme of maneuver determine the number of sapper squads needed and where mobility assets are placed in the order of movement.

Time and materials will impact his defensive capability. The force array in the security zone and main defensive belt impacts the amount of defensive preparation. Indirect-fire systems can only service one priority target and must shift to cover other targets, which may help in adjusting the obstacle template. Locations and movement of mounted weapons may indicate usable lanes for our infiltration of vehicles.

Event Template

Determine what triggers the commitment of enemy counterattack forces. Determine what situational obstacle capabilities he has, where and for what purpose the capabilities will be committed, and what the triggers are. Determine the structures likely to be set for destruction (such as petroleum and natural gas storage facilities).

Friendly Forces Survivability Time Line

Construct positions to support the forward displacment of combat support and combat service support assets and limited command and control nodes. The survivability effort should be an essential part of the maneuver deception plan.

Breach Execution Matrix

This matrix helps task force engineers allocate assets and determine when in-stride and deliberate breach techniques are required. Specify where to use the MICLIC, hand-emplaced explosives, armored combat earthmover (ACE), armored vehicle-launched bridge (AVLB), and tank-mounted countermine equipment.

Decision Support Template/Decision Support Matrix

Help the S3 identify and plan branches and sequels to the plan. It is essential to know where engineers will culminate and how rapidly platoons can be consolidated, reorganized, and put back into the fight.

Execution Checklist/Operations Schedule

Develop with the S3 the operations schedule (OPSKED), which is a combination of key events from the synchronization matrix and associated code words. This product supports the decision support template and helps the battle captain and maneuver commander track the battle and make decisions. Prepare a rough execution checklist after receiving the warning order and continue to refine it during mission analysis. Finalize the checklist during wargaming and provide "bootleg" copies to task force engineers and squad leaders (see page 11).

Troop-Leading Procedures Time Line

Ensure that adequate time is available to prepare the rehearsal site and that rehearsals are directed and supervised by key leaders.

R&S Planning Considerations

Integrate engineer reconnaissance teams into the brigade R&S plan. Focus these teams on engineer targets such as landing zone denial, obstacles in the reduction area, enemy survivability on the objective, and obstacles on approach routes into the objective area. The named areas of interest (NAIs) assigned to engineers should have priority intelligence requirements (PIR) that determine the best reduction sites into the city and confirm or deny enemy fortification of key sites.

Precombat Inspections (PCIs)

After conducting precombat checks (PCCs), inspect materials used to mark obstacle bypass lanes. Conduct FM and HF radio communications exercises using the OPSKED and reports specific to the current operation. Inspect all maps for operations security considerations. Sterile maps are not required, but information provided on overlays should not compromise the attack plan. Overlays should portray only NAIs. Targets, pickup and landing zones, and link-up locations should not be on overlays taken into the objective area. All soldiers must clearly understand the NAI priority and associated PIR, casualty evacuation (CASEVAC) plan, abort criteria, compromise plan, exfiltration and link-up plan, and communications windows.

Mobility Planning Considerations

Providing mobility support to a maneuver force in a MOUT environment normally will require engineers to support multiple combined arms breaching operations. The reverse planning process discussed in FM 90-13-1, *Combined Arms Breaching Operations,* applies to all terrain situations. The following considerations complement this process:

Conduct Approach March

Plan a primary route and an alternate route to support the movement of each maneuver battalion's combat forces. Clear these routes using standard tactics, techniques, and procedures (TTP). Control of movement routes is critical, particularly when ground evacuation is the primary method of removing casualties. Coordinate one-way, two-way, and alternating-direction traffic on routes with the brigade executive and operations officers. Identify decision criteria for switching to alternate routes. Maximize aerial reconnaissance of routes to identify possible obstacles, combat outposts, and ambushes.

Precombat Inspections. Conduct standard route-clearance PCCs and PCIs, which should be listed in the unit SOP. As a minimum check initiation systems, demolition charges, reduction equipment, marking materials, and mine detectors.

Rehearsals. Address all the breach tenets and explain the movement-control plan during each phase of the ground maneuver.

Secure the Foothold

Create lanes through obstacles using one sapper squad per lane, with a minimum of one lane per simultaneously assaulting platoon. (This does not mean nine lanes per infantry battalion. Analyze carefully.) Use adequate marking materials, guides for assault and follow-on forces, and lane hand-over procedures. It takes at least 30 minutes to "cycle" this squad back into the fight.

A squad cannot support breaching operations continuously. A decision point or trigger must support any changes in task organization and missions for engineers. Establish decision points for changing approach routes, reduction sites, and initiation of SOSR (suppress, obscure, secure, reduce).

Precombat Inspections. Equip the unit with bolt cutters (two per engineer squad), grapnels (three per engineer squad), a lane-marking kit, hand-emplaced explosives (10 per squad, per lane), mine detectors, and probes. Ensure that handheld smoke is available for each infantry soldier and that vehicles or utility helicopters carry smoke pots. Mass this smoke with the breach force at the objective rally point. Ballast load marking system upgrade materials on gun trucks. Use expedient reduction tools, such as Skidco litters, for wire reduction.

Rehearsals. No matter what rehearsal type or technique is used, perform basic SOSR rehearsals (see FM 101-5, *Staff Organization and Operation,* Appendix 6, for more information on rehearsals).

Suppress. Ensure that all personnel understand the location of support-by-fire positions and the pyrotechnic and radio signals to initiate obstacle reduction and indicate when the lanes are open (proofed and marked). The rehearsal site should have a full-scale lane-marking system visible to every soldier. All key leaders should understand the commitment criteria for the breach force.

Obscure. Rehearse triggers for artillery delivered, hand-emplaced, and vehicle-generated smoke. Consider the position of the moon relative to the support-by-fire position, the percent of illumination, and the night-vision goggle window.

Secure. Hold a combined arms rehearsal of the breach force using the full-dress technique. This rehearsal includes engineers and attached maneuver elements dedicated to suppressing direct fires and destroying local counterattacks.

Reduce. The combined arms rehearsal should include handing over lanes from engineers to maneuver soldiers. The rehearsal should be "NCO to NCO" and discuss details of linkup and handover. Consider the need to back-haul casualties when planning the number of lanes.

Seize Key Facilities

Plan procedures for dynamic entries into buildings and vertical envelopment, which require prepared special demolition charges (see FM 90-10-1, change 1), expedient assault ladders, and climbing grapnels. Rehearse the TTP for getting into windows on second and third floors. Have cutting tools available to prepare climbing poles at the objective rally point. Plan for subsurface entry. Consider the use of reducing wire in stairwells and hallways.

Precombat Inspections. Inspect special breaching charges (see FM 90-10-1, with change 1). Ensure that charges are properly constructed and that they will "stick" when placed. Use double-sided foam tape when placing vertical breaching charges during warm, dry conditions. Use spikes, braces, or Ramset-type power-actuated fasteners during rain or when temperatures are below freezing. Ensure that sufficient handheld and hand-emplaced smoke is available. Maneuver soldiers can carry smoke pots and additional explosives. Where practical, use battering rams (picket pounders or equipment found in MOUT areas) to enter doors. Conserve explosives by bringing one or two 24-inch crowbars to lift manhole covers and pry open entryways in buildings and sewers. Provide night-vision goggles to soldiers who reduce obstacles, because infantry leaders use infrared "tactical pointers" extensively, and reduction element soldiers must be able to see these signals. Use all available infrared lights. Mount and zero all AN/PAQ-4s and

AN/PVS-4s during the preparation phase of the mission. Engineers must bring handheld infrared light sources (such as Phantom lights or infrared filters on Maglites) and visible light sources (D-cell Maglites or SureFire TAC Lights) to help move and reduce obstacles inside buildings and subsurface structures. Ambient light inside hallways and underground is virtually zero, so plan for additional light sources. Mark cleared buildings so the marking is visible from rotary-wing aircraft and armored vehicles and by dismounted soldiers.

Rehearsals. Focus on the location and control of support forces and signals for commiting the breach force. Ensure that soldiers understand the minimum safe distance and the best reduction site based on the building structure. Clearly identify routes between buildings and the marking method for "safe routes." Deconflict building clearance markings from collection points for casualties, displaced civilians, and enemy prisoners of war. Rehearse close quarters combat drills for interior building clearing. Basic SOSR rehearsals from "secure the foothold" apply to dynamic entry into buildings, but these rehearsals usually focus on the infantry platoon and an engineer squad.

Civilians on the Battlefield/Enemy Prisoners of War. Establish "protected areas" for civilians on the battlefield, and clearly mark routes for displaced civilians. Consider an expedient countermobility effort to restrict access to these civilians and enemy prisoners of war. Liaison officers from psychological operations, civil affairs, and the military police should address this topic in the brigade maneuver rehearsal. Although there are no specific engineer requirements, be prepared to provide technical assistance during planning and execution phases.

Subsurface Fight. This is a variation on the theme of clearing buildings. Salient points are: entering the tunnel or sewer complex using hand tools or explosives, identifying and neutralizing mines and booby traps, and marking cleared areas. Navigation inside sewers and radio communications from inside the tunnel to aboveground soldiers is challenging. There is no ambient light inside tunnels, so plan and rehearse using infrared and visible light signals.

Move Within the City

Plan one vehicle lane per mounted platoon entering each section of the city. The lane through tactical and perimeter protective obstacles will become an "axis" for movement within the MOUT area. These lanes initially will support one-way traffic. Plan and rehearse traffic control as lanes become alternating traffic lanes to allow for CASEVAC. Improve at least one lane to two-way traffic and designate this as the primary CASEVAC route. Designate, clear, and mark a route from the casualty collection point to the CASEVAC primary and alternate helicopter landing zones. Use combat route-clearance techniques to clear the ground CASEVAC route. Reduce or bypass obstacles created by "junk vehicles," CONEXs, rubble, etc. If bypassing is part of the plan, make it a branch to the plan and include associated decision points and conditions.

Precombat Inspections. Inspect MICLIC and tank-mounted CME. Ensure that designated dismounted sappers have at least 20 blocks of TNT or C4 and 500 feet of detonating cord to reduce a 100-meter deep "lane" for vehicles. Inspect mine detectors carried by engineers designated to execute this mission. Sandbag one vehicle to use for proofing vehicle lanes, and dismount all passengers when proofing the lane. Ballast load additional lane marking material on vehicles. To assist the maneuver force in locating the correct lane to support their tactical plan, ensure that markings for multiple lanes are easily distinguished by day and at night. CASEVAC lanes must have a dedicated traffic control post (TCP). One technique is for this post to be initially manned by representatives from the medical platoon of the lead task force. Integrate a tank-mounted plow or properly prepared heavy vehicle (dozer, loader, or 5-ton truck with winch) into the plan to reduce rubble or junk vehicle obstacles.

Rehearsals. A combined arms breaching rehearsal is required according to FM 90-13-1. This rehearsal will serve as the final check for mission-essential equipment and final adjustments to the plan based on PCIs. Synchronize the establishment of support-by-fire positions to isolate reduction sites and trigger conditions for initiating reduction operations (the conditions and who makes the decision). Determine who shifts obscuration and suppressive fires and when they are shifted. Key leaders must rehearse handing over lanes to follow-on forces. Rehearse time-phasing the ground CASEVAC route clearance to helicopter landing zones and ambulance exchange points. Construct the unit's standard lane-marking system and route signs at the rehearsal site.

Countermobility Planning Considerations

Address these issues in the brigade-, battalion-, and company-level rehearsals. Plan to issue a scatterable mine warning (SCATMINWARN) to prevent fratricide.

Tactical Employment of Scatterable Mines

Plan in detail the employment of artillery-delivered antipersonnel mines/remote antiarmor mines (ADAM/RAAM) and multiple-delivery mine systems (Volcanos). Specify the target to be attacked, a tentative location, its effect (disrupt, turn, fix, or block), the delivery system, the observer, and the trigger.

Protective Employment of Scatterable Mines

Ballast load the Modular Pack Mine System (MOPMS) on vehicles moving into objective area blocking positions.

Engineer Staff Planning Checklist (Brigade and Below)

Plan

General

- ☐ Identify and resource all mobility/survivability essential tasks.
- ☐ Address all the breach tenets during planning and rehearsals.
- ☐ Request terrain products, MOUT layout diagrams, and data on building composition from higher headquarters.
- ☐ Study available terrain products to determine which subsurface routes to use and how to defend against enemy use of these systems.
- ☐ Study available maps and photos to determine the best routes to use when approaching the city and within the city. Determine where to establish casualty collection points, aid stations, and ammunition and water resupply points.
- ☐ Use scatterable mines to support engagement areas that block mounted counterattack routes. Disseminate this plan to critical maneuver and combat service support leaders.
- ☐ Establish essential engineer friendly forces' information requirements and no-later-than report times.
- ☐ Nominate engineer-specific PIR and associated NAIs to support the reconnaissance plan. Ensure that the latest time information is of value (LTIOV) is clearly understood. Decide what actions to take if the PIR are not answered before LTIOV.
- ☐ Disseminate the enemy obstacle template to all engineer leaders.
- ☐ Task organize engineers to support essential mobility/survivability reconnaissance missions.
- ☐ Determine how much and what types of obscuration smoke are available. Determine the wind direction and speed, which will impact the effects of smoke. Coordinate with the fire support officer for recommended uses of white phosphorus (both mortar and artillery delivered) and handheld smoke. Coordinate with the smoke platoon leader for duration of smoke and level of obscuration.
- ☐ Designate and clear routes for mounted forces and reserve forces.
- ☐ Identify the "conditions" and a decision point for initiating deliberate breaching operations during each critical event of the operation.

Approach March

- ☐ Designate routes for ground convoys and allocate engineers to clear them.
- ☐ Determine the clearance method and acceptable risk.
- ☐ Ensure that all vehicles have lane- and bypass-marking materials on board.
- ☐ Designate ground CASEVAC routes.
- ☐ Determine the decision point for using alternate routes.
- ☐ Determine when to establish TCPs/guides at critical obstacles on the route.
- ☐ Establish NAIs along the ground route to confirm or deny the enemy obstacle template.

Secure the Foothold

- ☐ Designate the best reduction site and technique based on enemy force array, terrain, and trafficability.
- ☐ Nominate NAIs for breaching operations.
- ☐ Designate one lane for each simultaneously assaulting platoon and the engineers needed to reduce it.
- ☐ Explain the lane-marking system.
- ☐ Establish a traffic-control plan for dismounted and mounted traffic.
- ☐ Establish a vehicle route and a dismounted route from the foothold to the CASEVAC helicopter landing zone.
- ☐ Designate locations for blocking positions to keep counterattacks from interfering with breaching operations. Resource blocking positions with MOPMS, conventional mines, and expedient barrier capability (such as abatis). Depict the planned locations of scatterable mines (include the safety zone) on maneuver and combat service support graphics to reduce fratricide.

Seize Key Facilities

- ☐ Designate buildings to enter and a reduction site that will support maneuver to the point of penetration.
- ☐ Designate where the support force will enter buildings.
- ☐ Resource battalions and their engineers with sufficient explosives and hand-emplaced and artillery smoke.
- ☐ Explain the cleared-building and cleared-lane marking systems.

Prepare/Execute

- ☐ Construct appropriate rehearsal sites to support maneuver and combat service support operations.
- ☐ Provide enough detail in the troop-leading procedure time line to encourage both engineer and combined arms rehearsals.
- ☐ Issue sketch maps and terrain products to engineers.
- ☐ Construct a lane-marking system and bypass-marking system that all vehicle drivers must go through en route to the objective area.
- ☐ Provide enough detail in the maneuver and engineer execution checklists to effectively use the Decision Support Matrix.
- ☐ Specify times for engineer-specific precombat inspections conducted by platoon leaders, company commanders, and first sergeants.

Consider sling loading the MOPMS, conventional mines, and limited barrier materials to support transitioning to the defense and blocking enemy counterattacks.

Engagement Area Development

Specify the engagement area to interdict the enemy counterattack force. Ensure that battalion and brigade reserve forces have specified routes to move to the engagement area. Engineers may not be available to emplace obstacles, so specify the engagement area development tasks, including obstacle emplacement and fire integration, to maneuver units.

Survivability Planning Considerations

Perform this work concurrently with initial reconnaissance and "condition setting" by the brigade to support the brigade and division deception plans.

Field Artillery. Determine positioning areas and plan counterfire radars and ammunition stocks.

Forward Area Refuel Point. Establish locations for stocking fuel and ammunition. Plan for multiple refueling sites to support the attack and lift aviation simultaneously.

Advance Trauma Lifesaving Sites. Locate forward treatment facilities and ingress/egress routes. The implied task is to establish helicopter landing zones for these sites.

Summary

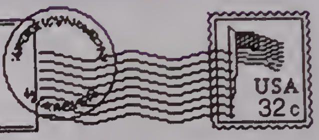
While the process for planning engineer support to a MOUT attack follows existing decision-making steps, engineer planners must understand how this diverse terrain impacts engineer operations. Critical points include:

- Structures become key terrain.
- Belowground and multilayered aboveground dimensions are added.
- Terrain enhances the enemy's countermobility and survivability efforts and increases the friendly force's mobility requirements.
- Decentralized execution—while staying collectively synchronized—is required.
- MOUT-specific precombat checks, precombat inspections, and rehearsals must be conducted.

By accounting for these impacts, engineer planners can make sound decisions to set the stage for effective engineer support to the maneuver force in this demanding environment.

Captain DeJarnette is an engineer observer/controller at the Joint Readiness Training Center, Fort Polk, Louisiana. He previously served with the 37th Engineer Battalion, Fort Bragg, North Carolina, and as commander, B Company, 11th Engineer Battalion, Fort Stewart, Georgia.

Letter to the Editor



Several readers had questions regarding the article "The MARTEN: A Quantum Leap for Engineers" in the February 1998 issue (page 18). Some questioned the name MARTEN. The following information will clarify any misconceptions we may have unintentionally raised.

Using the TRADOC Concept Evaluation Program, the Engineer School obtained from Melroe Company a Model 763 skid steer in 1997 for evaluation. Their company logo reflects the face of a bobcat and their skid steers are called "Bobcats," a copyrighted name we could not use. The MARTEN is the author's name and is not official.

The article might also lead one to believe that the Army spent millions developing a system that is readily available as a commercial off-the-shelf (COTS) purchase. That is not so. The Engineer School leased the skid steer and all its attachments at a very favorable rate and has since returned it to the manufacturer.

The purpose of our evaluation was to quantify the increased performance afforded by a skid steer. The data and evaluation results are necessary for school personnel to create requirements documents, a process that eventually will result in fielding the skid steer to engineer and other units.

If readers focus on the name MARTEN versus Bobcat and not on how well the MARTEN performs, they completely miss the point. It's what the system brings to the engineer on the battlefield that is important. A system capable of increasing an engineer squad's productivity by 25 percent can be called anything you want, just have it available! If you've ever constructed a concertina fence by driving the pickets with a sledge hammer, I'll bet you'd rather have something (a MARTEN?) with a hydraulic picket-pounding attachment.

I encourage units that have utilized skid steers to submit after-action reports or comments to the Director of Combat Developments using the comment form on the Engineer School home page at http:\\www.wood.army.mil.

Alan Schlie
Force Development Analyst

ENFORCE
BREAKOUT SESSION SUMMARIES

By Lieutenant Colonel Susan Myers and the ENFORCE Team

ENFORCE Conference breakout sessions are evolving into a regimental think-tank, and the information they provide is valuable to staff and action officers working issues that impact our engineer force. Other sources of communication, such as the Engineer Center home page, video teleconferences, council of colonels, and e-mail newsletters, offer opportunities to link engineer leaders with the latest developments. Summaries of breakout sessions held during the April 1998 engineer conference follow. Some have been updated to reflect actions taken since the conference.

Echelons Above Division

By Peter Malley

This session had two purposes: First, to inform participants about proposed engineer force structure requirements to support Force XXI, new evolutions of the battlefield, and future redesigns of the echelons above division (EAD) organizations. Second, to seek input to assist in determining the "right" designs for EAD organizations based on wartime missions and future concepts—i.e., Force XXI and Army After Next.

We began by explaining how engineer structure is developed from approved doctrine, concepts, and comments from field personnel. We described how the workload allocation rule for the Engineer Battalion, Combat Heavy, was developed using 23 wartime tasks and the number of personnel assigned to the unit. This discussion raised the following questions:

- ❑ **Why aren't equipment hours factored into the workload allocation rule?** We asked the Concepts Analysis Agency to answer this question. The data used to determine engineer requirements is based on information provided by the Engineer Strategic Studies Center and identified wartime tasks. Neither of these sources itemizes equipment hours. Engineer School leaders will review this issue to determine if equipment hours can be factored into the workload allocation rule.
- ❑ **Who will develop the EAD operational and organizational (O&O) plan for Corps XXI?** TRADOC is developing the Corps XXI O&O plan. It will be accomplished through a series of workshops attended by proponent school personnel. A "tiger team" has been developed to provide engineer input on specific issues. The tiger team includes doctrinal and concept developers and is chaired by a colonel.
- ❑ **Will the engineer organization include one engineer group with planning capabilities or will a modular section be available to augment the senior engineer organization in theater?** This question will be answered during the Corps XXI redesign process, which will be completed by October 1998.

We briefed the evolution of the future battlefield layout and potential roles for engineers. MG Flowers provided his guidance and perceptions in response to questions. This topic will remain a hot issue and will be reviewed as it develops.

We discussed proposed redesigns of EAD organizations. Two major organizations, the Engineer Combat Battalion, Corps Mechanized, and the Engineer Battalion, Combat Heavy, were described in detail. Others, such as the Engineer Command, the Combat Support Equipment Company, and the Engineer Combat Battalion, Corps Wheel, were summarized. Participants were most concerned about the following units:

- ❑ **Engineer Combat Battalion, Corps Mechanized.** Today this unit is a mirror image of the heavy division battalion. Participants concurred that the organization requires changing and that it should be revised based on breaching, survivability, countermobility, and general engineering capabilities no longer available within the heavy division battalion. We agreed to review the possibility of adding a Delta Company in the design and discussed adding more 62 MOS operators and reducing the number of combat engineers. We agreed to consider replacing ACEs with D7 dozers—that decision will depend on the availability of ACEs. Questions were raised about requirements for the CEV (future) and the Panther. Consensus was that a "bunker buster" or some type of weapon could be used in lieu of the CEV (future), and that the Panther could be placed in war stockage and withdrawn when necessary. The group suggested that we replace the M548s (Volcano vehicle) with a newer version and provide a dedicated support vehicle for MICLICs. We agreed to add a property book officer to this organization because the unit has considerable property that requires this officer's expertise.
- ❑ **Engineer Battalion, Combat Heavy.** After reviewing the mission statement, most participants agreed there is no requirement for bituminous paving, quarrying, or crushing operations. Engineer School personnel will review this requirement during the redesign process. We reviewed the 23 wartime tasks and recommended that three more be added: force provider, chemical decontamination support, and lines of communication bridging requirements. It was suggested we also add range construction and road construction and upgrading to the list.

The Concepts Analysis Agency agreed that these tasks can be added if the commanders in chief (CINC) have these requirements. The tasks will be added based on CINC input.

- **Engineer Command.** The Engineer School requested that representatives from the two engineer commands review their tables of organization and equipment (TOE) to determine whether this unit can be redesigned using modular sections versus the standard TOE staff positions. They agreed to this request.
- **Engineer Brigade, Theater Army.** Requirements for the brigade headquarters are not clearly defined in engineer doctrine. Colonel Quinn, 411th Engineer Brigade, provided a paper that identifies the brigade tasks. His data will be used to define the unit's mission and roles in future force structure requirements.
- **Engineer Combat Battalion, Corps Wheel.** Several commanders wanted to discuss this organization, but we could not because no proposed redesign has been developed. The commanders agreed to review their Unit Reference Sheets and submit suggestions for the redesign.
- **Engineer Combat Support Equipment Company.** Two options were raised: The Engineer School either develop a workload allocation rule or embed this company in the Corps Mechanized and Wheel Battalions. Consensus is that this unit must remain in the structure because its capabilities are critical to adequately support divisions.
- **Engineer Battalion Headquarters Team.** Participants requested that the Engineer School develop a team to command and control the separate corps companies and teams. Engineer School staff are reviewing this proposal.
- **Engineer Terrain Analysis Platoon.** We briefed a proposed redesign, which has increased the number of Active Component spaces to support terrain analysis requirements. Participants suggested we place some of the platoon sections in the Reserve Component structure. The Terrain Visualization Division is reviewing this proposal.

Comments and suggestions regarding this session are welcome and may be sent to the following e-mail address: malleyp@wood.army.mil.

Digital Breach Operations

By Lieutenant Colonel Harry Greene

This session began with presentations on the Wolverine and the Grizzly, which will form the backbone of the future heavy divisions' breach capability. When fielded in FY00 and FY04, respectively, both the Wolverine and the Grizzly will have situational awareness capabilities similar to those of the supported heavy maneuver force. We also discussed engineer command and control and the engineer portion of Force XXI Battle Command Brigade and Below (FBCB2). After these briefings, we posed the following questions to stimulate discussion:

- Given the information dominance provided by a digital force, do leaders still need to conduct a dismounted reconnaissance to determine the best breach site?
- Can we reduce the number of breach rehearsals or change the type of rehearsals conducted?
- Is it smart to use an M1 tank to follow reduction assets through a lane and provide security?

While we did not come to resolution on these questions, we will use the information and opinions gathered to shape future doctrine development for digital breaching operations. Several themes recurred during our discussion:

- Digitization and the resulting information dominance are most useful before and after a close fight. During a close fight, we expect communications to be conducted by methods similar to those used today. Attendees agreed that FM radios provide the most responsive form of communication at critical points in a battle.
- Marking lanes digitally is most valuable when vehicles approach the breach lane. Manually marked lanes are still required at the entrance and as vehicles move along the breach lane.
- Humans will remain a critical element on the digitized, situationally aware battlefield. Human eyes are needed for reconnaissance, and leadership is critical at the breach.
- Digitization and situational awareness were discussed at length. Participants agreed that digitization will increase the availability of information and the speed at which information is disseminated. We did not agree on how that information will impact the decision-making process.
- The presentation on engineer use of FBCB2 provoked lively discussion on reporting and command and control links. Engineer School leaders are working to clarify the types of reports required and the proper flow of reported information.

This breakout session served as a means to continue ongoing dialog concerning how digitization and situational awareness will impact engineer operations. Discussion will continue in *Engineer* magazine and at future ENFORCE conferences. The point of contact is guilford@wood.army.mil.

Force XXI Topography

By Lieutenant Colonel Earl Hooper

We began with a review of Task Force XXI and Division Advanced Warfighting Experimental designs and insights for future topographic missions. Most of the discussion focused on Topographic Force Structure 2010. The Terrain Visualization Center is developing future topographic structure options, and two major options were presented. Lieutenant Colonel Hooper described a single theater battalion with robust corps companies. Lieutenant Colonel Luce (commander of the 29th Engineer Battalion) presented a two-battalion design with heavy theater companies and a unified brigade headquarters. Both designs focus on a set of key factors, which will drive future topographic missions and which, in turn, will drive our doctrine. Descriptions of the key factors follow.

- **A common terrain operating environment (CTOE).** This does not mean that we all have the same view of terrain. We know that requirements for terrain visualization, analysis, simulation, and modeling differ across each battlefield operating system and across each echelon. The CTOE is the commonality of the underlying terrain data that drives each system to accomplish its terrain visualization and evaluation missions.
- **Rapid data production and data dissemination.** Data production from the National Imagery and Mapping Agency (NIMA) is critical. That agency's future plans call for it to provide foundation data "on the shelf." The foundation data will not meet all terrain data requirements for our future digitized organizations. Rather, that data must be reinforced with more detailed data sets produced "just in time" to support military operations. The "just in time" data production forms the basis of mission-specific data sets (MSDS). For the Army topographic community, this opens two new missions. The first is to get rapidly produced data to digital systems throughout the battlefield. The second is to fill data voids in the MSDS with data produced by Army topographic elements. The NIMA phrase used to represent this sift in data production philosophy is "just in time, not just in case" data production.
- **Expanded availability of terrain analysis support.** Future digital command and control systems offer extensive communications connectivity. This allows the analysis and dissemination of terrain data. Previous terrain analysis efforts normally reached only G2/G3 elements due to limited personnel and the low volume of hard-copy products. Digital distribution allows each command and control node down to the maneuver battalion level access to many of the analysis products previously limited to operations and planning elements at division level or above.
- **Embedded terrain evaluation in command and control systems.** Each system can perform many basic evaluation tasks and develop visualization products formerly provided by terrain analysis teams. These tasks include lines of sight, masked area plots, intervisibility plots, oblique views, perspective views, and slope analyses. Embedded tools allow individual users to obtain many visualization products without direct support from a topographic element. This capability is key to the overall terrain visualization mission in Force XXI. Topographic missions continue to shift toward data creation, management, and dissemination. The new missions provide the terrain data that empower the evaluation capability embedded in future command and control systems.

Attendees at this session provided an excellent cross section of the engineer community. The collected expertise included all topographic battalion commanders, the commandant of the Defense Mapping School, and the commander of the Topographic Engineering Center. The session closed with comments from MG Flowers and BG Arnold. They encouraged the team not to focus on fixing the existing structure but to design a structure that will meet future requirements.

The Terrain Visualization Center is working with the Concepts Division of the Directorate of Combat Developments and the Engineer Personnel Proponency Office to expand the two echelons-above-division options noted above. The assistant commandant provided an initial review and guidance in June. We are preparing a detailed concept design that will be staffed throughout TRADOC this fall. The point of contact is hoopere@wood.army.mil.

Long-Range Experimention Plan

By Vern Lowrey

The Maneuver Support Battle Lab (MSBL) hosted a breakout session to discuss engineer-related experimentation proposals as far forward as FY01. We briefed the battle lab experimentation process described in TRADOC Pam 71-9, *Requirements Determination.* We also discussed an ongoing effort by TRADOC to expand Army experimentation efforts over five axes:

- **Army XXI axis** to determine final requirements for the First Digital Division (FDD) by FY00.
- **Corps/Echelons Above Division axis** to experiment with structures needed to support the FDD and follow-on digital divisions that support fielding the First Digital Corps (FDC) by FY06. A corps Advanced Warfighting Experiment (AWE) will be conducted in FY03.
- **Joint Contingency Force axis** to experiment with contingency and expeditionary forces will culminate in an AWE planned for FY02.
- **Battle Force Group/Strike Force axis** to experiment with concepts tied to a highly lethal and deployable force.
- **Army After Next axis** to continue intellectual thought and discussion on Army force requirements beyond the year 2025.

We then discussed proposed engineer-related experiments based on the new Army patterns of operations (project the force, protect the force, gain information dominance, shape the battlespace, conduct decisive operations, and sustain and transition the force). Resourced MSBL experiments will tie into each Army axis as appropriate.

Feedback from ENFORCE participants was extremely helpful in validating engineer-related experiment proposals.

Tighter linkage of MSBL experiment efforts was discussed with the Director of the U.S. Army Corps of Engineer laboratories. A proposal was made to tie materiel-related experiment efforts with existing operational requirement documents to determine if the requirements are still valid or need modification.

The MSBL Long-range Experimentation Plan (LREP) has been staffed with the U.S. Army Chemical, Engineer, and Military Police Schools. It is posted on the MSBL Internet home page. Comments or suggestions for future engineer-related experimentation ideas are welcome. The point of contact for the LREP, Major Steve Jeselink, may be reached at (573) 563-4082 or Defense System Network (DSN) 676-4082.

The Bradley-Equipped Engineer Company

By Lieutenant Colonel Dick Hornack and Major Doug Victor

During this session, we solicited input concerning the Engineer Regiment's transition to the Bradley engineer fighting vehicle (BEFV). The Engineer School will use data from the session to develop and finalize an operational and organizational (O&O) concept to incorporate into the BEFV concept evaluation plan. The O&O concept will address the optimum organization for the engineer company, training issues, and doctrinal impacts of a Bradley-equipped engineer force. The Maneuver Support Battle Lab will continue to work this action.

Subject areas used to facilitate discussion were engineer company and platoon organizations, training and doctrinal implications, and follow-on testing that will fully develop the Bradley engineer company concept.

Engineer Company Organization. Engineer combat repair teams and combat service support should mirror requirements of the maneuver community. First sergeants should be in M113s along with the repair teams. Company commanders/operations sergeants must have a HMMWV, so we need to relook HMMWV distribution within engineer companies. Units may not be able to deploy with 100 percent of their assigned systems due to soldiers who are sick, on profile, etc.

Engineer Platoon Organization. Reduction platoons should have redundant capabilities to reduce obstacles and proof and mark lanes. They need the armored combat earthmover (ACE)—a mobility asset—organic to the platoon to complement other reduction assets. The ACE can reduce antitank ditches and berms (constructed obstacles) and provide proofing capability through complex obstacles. Maintaining the ACE in reduction platoons will minimize task organization changes for offensive operations within engineer companies.

Training Implications. We presented three proposals for engineer gunnery:

☐ Fire tables I-VIII.

☐ Fire tables I-VIII; don't fire tables III and IV.

☐ Fire tables I-VIII (Modified); don't fire tables III and IV.

The group thought that engineer gunnery tables should parallel the maneuver tables I-XII, with tables XI and XII being the squad and platoon qualifications, respectively. Engineer qualification tables should be merged into the current Bradley tables I-XII to create an engineer gunnery program with an end state of completely qualified squads and platoons. The Engineer School will continue to work engineer gunnery issues, including resources.

Doctrine Implications. Engineer commanders expressed concern that four Grizzlies may be insufficient to support a maneuver task force during breaching operations, since we need to make as many breach lanes as possible for the assaulting task force. Engineer companies must retain as much of their current breaching capability as possible, because the Army will buy only a limited number of Grizzlies.

Follow-On Testing. To help Engineer School personnel analyze the Bradley engineer company, the 4th Infantry Division's engineer brigade transitioned one engineer company to BEFVs in April 1998, using the same configuration as the infantry Bradley company. An Engineer School team will evaluate this concept, including load plans, maintenance, training, and doctrine. The 4th Infantry Division will test the concept throughout the summer and will deploy to the National Training Center in August with two engineer companies—one Bradley company and one M113A2 company.

The Engineer School will continue to evaluate engineer gunnery tables, engineer qualification tables, ammunition implications, the feasibility of adding a bunker-busting munition to the tube-launched, optically tracked, wire-guided (TOW) missile, and the need to change to the Bradley stowage capacity to accommodate engineer equipment. A proposed FY99 concept evaluation plan will address enhancements to the Bradley, which include rollers, plows, Volcano, MICLIC, and possible hydraulic/pneumatic tools. The point of contact is steinigp@wood.army.mil.

Total Army Training System Courses

By Lieutenant Colonel Susan R. Myers

We provided information about the Total Army Training System (TATS) courses and solicited feedback as to how material should be fielded throughout the engineer regiment.

The Total Army School System (TASS) is the realization of former Chief of Staff of the Army General Gordon Sullivan's vision for the Active and Reserve Components to train to the same standard. His vision is being realized now that seven functionally aligned training battalions offer reclassification courses to the engineer Reserve Components. TATS courses are the means to standardize training technical tasks, and the Systems Approach to Training (SAT) is the process used to develop programs of instruction.

Systems Approach to Training

The Training and Doctrine Command updated the SAT process in 1995 to re-establish a long-term approach to planning future training requirements for TATS courses.

SAT has five interrelated phases: analysis, design, development, implementation, and evaluation.

Analysis. This phase identifies and describes collective and individual tasks and determines what needs to be trained. Analysis for TATS courses is accomplished by bringing together representatives from all components to determine training needs. Achieving consensus on training needs and critical tasks is a difficult process. The Engineer School received Active Duty Special Work funds to help ensure that feedback from field commanders and Reserve Component instructors is integrated into the analysis phase.

Design. This phase ensures the systematic development of training programs and materials to enhance the learning process and make it more effective. Virtual and diagnostic learning strategies being incorporated into TATS courses will require access to and fielding of technological learning systems. Linking these systems is critical to the success of future training capabilities, and the medium to accomplish the link is component distance learning plans.

Development. This process turns the design into training products, programs, and materials required to implement training. The program of instruction, lesson plans, student handouts, soldier's manuals, and interactive courseware are products of the development process. Combat engineer courses were validated this year (1998) at Fort Leonard Wood, Missouri; the Army National Guard Regional Training Institute at Camp Grafton, North Dakota; and the Army Reserve engineer TASS battalion at Camp Dawson, West Virginia. This validation process ensures that training issues from all components are incorporated. Construction and equipment operator courses will be completed this fall. All courseware will be available for distribution from the Army Training Support Command in October 1999.

Implementation. During this phase, courses are conducted using training materials and exercises based on unit training needs. The implementation process is expanding to accommodate training battalion evaluation criteria mandated by the TRADOC accreditation program.

Evaluation. Units are evaluated annually, and TASS battalions are accredited every three years (as a minimum). The accreditation system evaluates instructor and student performance, instructor credentials, testing programs, course materials, and training resources. Some of the Engineer Regiment's greatest challenges are to plan and resource training to meet military occupational specialty qualification quotas and, more importantly, to ensure that soldiers are prepared to perform critical technical tasks to standard before graduating from the course.

The Future

Engineers must continually assess both individual and collective skills and knowledge to anticipate future training requirements. Acquiring resources for training is often the weak link because of changes in doctrine and lead times needed to procure materials. Distance learning is touted as the solution to reducing the time required for training. However, our technical skills and knowledge are perishable without continuous reinforcement and practice. The Director of Training seeks feedback and lessons learned concerning training needs, distance learning, and training effectiveness from unit commanders, training commanders, and other training experts. Leaders must learn more about the TATS courses. They are the tools to train the entire Force XXI Engineer Regiment and the bridge to bringing the Active and Reserve Components together for readiness. The point of contact is stephens@wood.army.mil.

Training Modernization

By Connie Welch and Al Waltman

This session presented the Engineer School's initiative to modernize engineer training. Participants were shown prioritized lists of modernization initiatives developed by the school's Training Modernization Integrated Concept Team and were asked to comment on the list's completeness and priorities.

Updated priority lists follow.

Maneuver Engineering

1. Training aids, devices, simulators, and simulations (TADSS) to support staff training in the technical engineer areas of breaching, force protection, obstacle planning, and river-crossing operations.
2. Computer-based training and simulations to train general tactical operations center (TOC) procedures.
3. TADSS to support mine detection (virtual-reality-based).
4. An improved mine-effects simulator for the combat training centers.
5. An armored combat earthmover (ACE) simulator.
6. A Volcano simulator.
7. More training events integrated with other TRADOC schools and between courses at the Engineer School.
8. A large, regional, fast-water, river-crossing training area for the Army.
9. A bridge boat operator and raft commander simulator.
10. Multimedia training to support bridge design and Bailey bridge/medium girder bridge simulators/simulations.
11. An improved mine-clearing line charge (MICLIC) and MICLIC trainer.
12. A remedial math class or computer-based training.

Force Support Engineering

1. TADSS to support heavy construction engineer equipment, such as dozers, graders, scrapers, loaders, and SEEs.
2. TADSS similar to a simulation network to support construction engineering activities.
3. A base camp demonstration site at Fort Leonard Wood for resident training, similar to the model motor pool or the military operations in urban terrain (MOUT) facility.
4. A handheld electronic expert system, which will contain the equivalent of FM 5-34, *Engineer Field Data,* and perform calculations.
5. A simulation to support engineer and route reconnaissance.
6. Move reclassificaton training to the Total Army School System battalions.

Terrain Visualization

1. Embedded training for the Digital Topographic Support System.
2. Digital terrain training support package (CBT) for producing map products.
3. Maneuver Control System and Joint Mapping Tools Kit training in leadership courses in the Engineer School.
4. Computer-based training that demonstrates battlefield obscuration and its effects on engineer operations.
5. A camouflage training site at Fort Leonard Wood.
6. Re-evaluate the initiative to move the Defense Mapping School to Fort Leonard Wood.

Systematic/Process Topics

1. Revitalize the individual training program process to identify resource requirements, and develop and program a training strategy.
2. Nonsystem TADSS acquisition system fails and requires redesign too often.
3. Review course length limits versus increasing skill complexity due to new technologies.
4. Standardize DoD equipment: Multiple brands of equipment across the total force cause problems.
5. Human factors are not included in training and equipment designs.

Participants made the following recommendations.

- Add Volcano and ACE training devices to the maneuver engineering list.
- Separate survivability issues from force protection issues on the force support list.

The second portion of this session was devoted to the Engineer Force Battle Command and Staff Trainer modernization initiative. Suggestions included:

- Consider consolidating the analog and digitized CD-ROM. Digitized training could be an annex or add-on to the analog CD-ROM.
- Add a company support platoon leader trainer.
- Add a company-level supply position trainer.

Engineer School personnel are reviewing these recommendations and will incorporate them into final prioritized lists. The lists will be presented to the school commandant for approval by mid-August 1998. The point of contact for training modernization at the Engineer School is waltmana@wood.army.mil.

Engineer Officer Advanced Course

By Major Darren Naumann

The purpose of this session was to brief results of the EOAC customer survey and Task Site Selection Board and discuss the Total Army Training System-Courseware (TATS-C) and EOAC-Reserve Component Distance Learning Implementation Plan. We also solicited input for improvements to the EOAC.

EOAC Survey. The group agreed that the EOAC customer survey is valid but were concerned that the top 10 tasks reflect priorities facing a peacetime Army. They thought that survey results should not drive the train for EOAC course instruction but should be viewed as one of many inputs to the course design. We discussed the complexity level of tasks instructed in the EOAC—whether they are the most difficult or most often encountered—and agreed that the course should focus on foundation skills on which the officer can build.

Consensus was that the survey be conducted annually, that it is beneficial for commanders to provide input to EOAC design, and that we should administer a similar survey to maneuver commanders. The following improvements were recommended:

- Change the cover letter to emphasize the importance of commanders' input to the course.
- Change the wording of questions to reflect the survey purpose; for example, "What important skills and knowledge should be taught in the EOAC?"
- Provide commanders the ability to quantify the detail level of skills and knowledge taught; for example, differentiate between "integrated," "awareness," "refresher," and "programmed" training.
- Administer future surveys to EOAC graduates as well as battalion/brigade/group commanders. To reduce costs, commanders will be responsible for distributing surveys to EOAC graduates in their command.
- Distribute future surveys to U.S. Marine Corps engineer unit commanders.

Task Site Selection Board. The group thought that the critical task list and recommendations from the board were not indicative of the engineer branch as a whole but reflected the types of units represented on the board.

Total Army Training System-Courseware. The group recommended that lesson plans for tasks encountered least often be converted and published first under the TATS-C program.

Distance Learning Implementation Plan. Participants agreed that it may be difficult to synchronize quarterly video teletraining and mobile training team sessions with Reserve Component units. They recommended that the sessions be archived so students can access them.

Recommendations. Teach EOAC students to be managers, not technicians, and focus instruction on management-level issues and systems that company commanders should know. Increase students' exposure to issues relevant to today's fight, such as support operations and stability operations, rather than focusing entirely on fighting "World War III." The point of contact is naumannd@wood.army.mil.

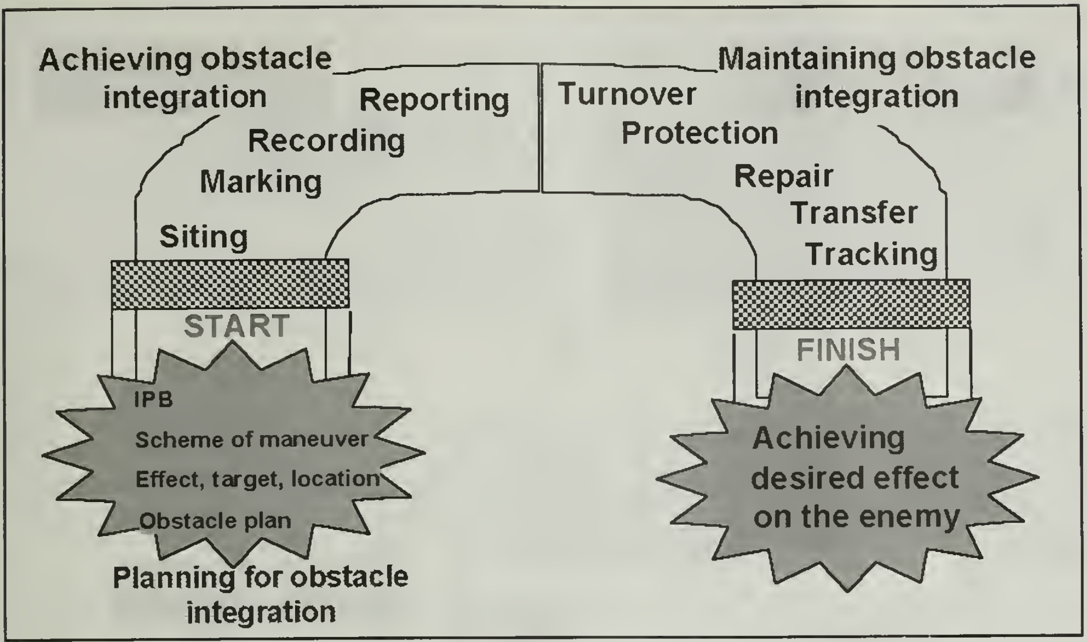


Figure 1. Planning, achieving, and maintaining obstacle integration

Scatterable Mine Systems and Integration

By Major David Holbrook, Major Michael Rose, Major Darold McCloud, and Mr. Charles Jackson

We discussed and solicited feedback on negative combat training center trends, current doctrine, and future systems related to scatterable mines. Attendees reviewed several trends related to scatterable mine employment and integration across DTLOMS, with doctrine, organization, and materiel trends being most notable. Engineer School personnel will work these issues based on information obtained during the session.

Doctrine

We agreed to develop a graphic training aid (GTA) that outlines system checks for the Volcano and MICLIC. Consensus was to limit the Volcano section to the ground Volcano, since aircraft crew chiefs conduct additional (nonengineer-related) checks on the air Volcano that are inappropriate for an engineer GTA. The group suggested that system checks for the MOPMS be included on a future GTA.

We discussed scatterable mine integration concepts in current doctrine. FM 90-7, *Combined Arms Obstacle Integration*, now being reviewed by the field, will contain information on planning, achieving, and maintaining obstacle integration (Figure 1). We concluded this section by discussing available scatterable mine assets and points in the military decision-making process that will assist leaders in planning scatterable mine integration.

Terminology was discussed in detail, particularly the term "dynamic obstacle," which emerged during the National Training Center's Advanced Warfighting Experiment (AWE) in March 1997 and was used in the Division AWE at Fort Hood last fall. Although the term has never been defined, it continues to show up in correspondence and in lessons-learned documents circulating through the Engineer School.

The term "dynamic" is frequently used in Force XXI operations, and engineers must embrace it. The Army is rapidly changing, and doctrine must keep pace. The "dynamic battlespace" we fight in today is leading the way for future systems that reach out and kill the enemy at greater distances. The Raptor is a system that fits this mold.

"Dynamic" in itself has a single meaning, but when added as a descriptor at the beginning of existing doctrinal terms, it requires definition in the doctrinal lexicon. According to Webster, "dynamic" is defined as (1) forceful; energetic (2) of or pertaining to force or energy related to motion. We proposed that to be "dynamic" an obstacle must—

- ❒ Communicate with command and control systems and other engagement systems.
- ❒ Be remotely controlled (on/off/on).
- ❒ Report battlespace intelligence (type, number, direction, and rate of movement).
- ❒ Be delivered remotely.
- ❒ Engage vehicles.

While these descriptors apply to the *future* Raptor system (see materiel section), they do not apply to current scatterable mine systems.

Participants thought we do not need another term to describe our obstacles, but they provided some interesting insights and acknowledged that many leaders use the term "dynamic obstacle." The term will be defined in future doctrine, based on the above criteria and the following synopsis of the attendees' comments:

- ❒ *Obstacle*—If it is not an obstacle, it is not linked to engineer proponency.
- ❒ *Dynamic*—Has on/off/on capability at least once.
- ❒ *Active*—Sensors are not active; they only receive. Mines are passive, while radar and sonar are active. To be "dynamic" a system must be active.
- ❒ *Mobile*—Replace the term "mobile" with "interactive" when describing the Raptor.

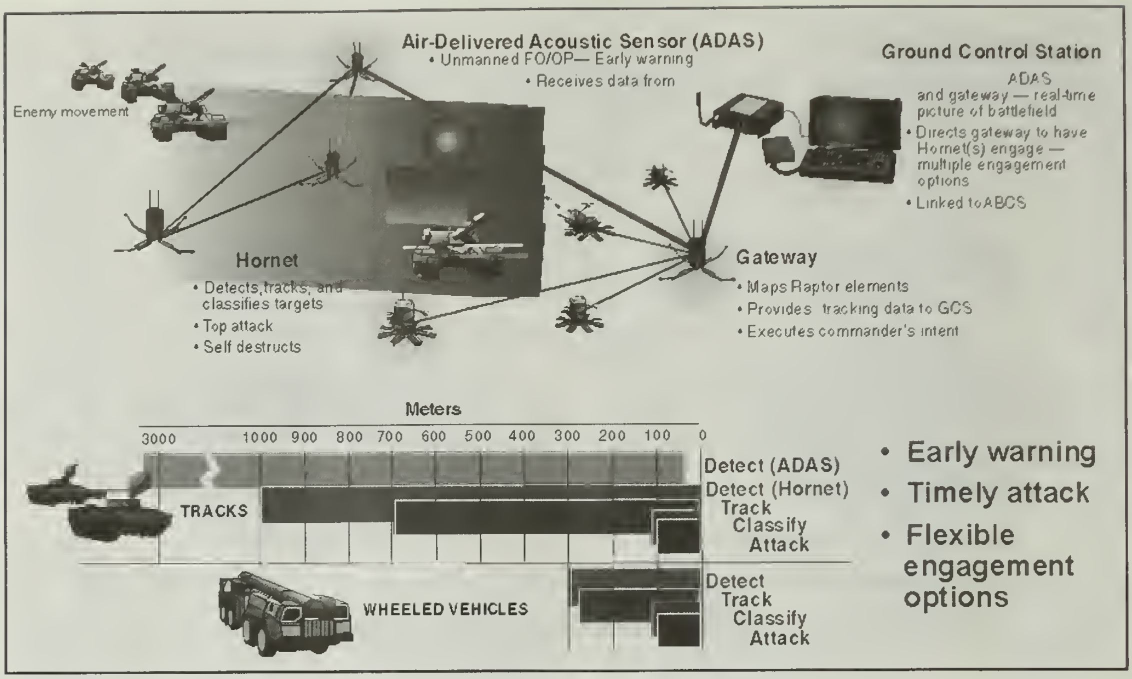

Air-Delivered Acoustic Sensor (ADAS)
• Unmanned FO/OP— Early warning
Enemy movement
Ground Control Station
• Receives data from ADAS and gateway — real-time picture of battlefield
• Directs gateway to have Hornet(s) engage — multiple engagement options
• Linked to ABCS
Hornet
• Detects, tracks, and classifies targets
• Top attack
• Self destructs
Gateway
• Maps Raptor elements
• Provides tracking data to GCS
• Executes commander's intent
Meters
3000
1000
900
800
700
600
500
400
300
200
100
0
TRACKS
Detect (ADAS)
Detect (Hornet)
Track
Classify
Attack
WHEELED VEHICLES
Detect
Track
Classify
Attack
• Early warning
• Timely attack
• Flexible engagement options

Figure 2. Raptor - A Force XXI Capability

- ☐ *Desired Effect*—Allows free mobility for the BLUE; is an obstacle to the RED; and is no danger to the GREEN (noncombatants).

Organization

Attendees agreed that the M548 Volcano carrier should have a communications platform for mounting a radio to enhance command and control of this critical asset.

Materiel

Suggestions concerning a standard minefield-marking system included:

- ☐ Establish the standard at theater corps level at the beginning of each operation.
- ☐ Use a material for the marking system that is readily available to all units.
- ☐ Include minefield-marking material in the STRAC manual.
- ☐ Ensure that the minefield-marking material can be used by both heavy and light forces.
- ☐ Adopt the Pearson Pathfinder marking system used by the British army.

Volcano Minefield-Marking System (VMMS). We discussed this possible future system, which would eliminate some negative trends users experience with the current Volcano at combat training centers. The VMMS will automatically mark the Volcano minefield as it deploys. Participants approved this concept and suggested improvements to be incorporated under the Volcano improvement plan. The VMMS should have a communications platform and built-in Global Positioning System (GPS) and be capable of being carried by soldiers (man-packed). This last feature will enable soldiers to rapidly mark any unmarked areas created by terrain or the system itself.

Self-Destruct Times. We agreed that different self-destruct times should be developed for our scatterable mine systems. The current times of 4 hours, 48 hours, and 15 days (for the Volcano) are not conducive to future mission execution. Suggestions included:

- ☐ Base changes to self-destruct times on enemy echelonment; for example, the duration should cover the time when the first echelon enters the main battle area through culmination of the second echelon.
- ☐ Change the times to 12 hours, 48 hours, and 15 days.
- ☐ Change the times to 4 hours, 18 hours, and 48 hours.
- ☐ Align all systems that have the RCU-controlled MOPMS with a command-detonation option.
- ☐ Increase the availability of scatterable mine Class V supplies (ammunition).

Raptor. Previously called the intelligent minefield (IMF), the Raptor is both a weapon and an information-collection system, which makes it hard to categorize. The system consists of air-delivered acoustics sensors, Hornet munitions, a gateway, and a ground-control station (Figure 2). Several suggested improvements to the Raptor concern safety and utility. The group thought the Hornet should have a disarm-and-reuse capability after it is fully armed. Currently the Hornet can be redeployed before final arming, but it either self-destructs at a preset time or is remotely command detonated when fully armed.

Conclusion

The ENFORCE Conference breakout sessions keep leaders of the Engineer Regiment informed of ongoing issues. Feedback gathered during the sessions will be extremely helpful in developing future doctrine and engineer systems. Your continued interest and support are appreciated.

Standardized Training Using Engineer Qualification Tables

By Sergeant First Class Russell Marth

Engineer Qualification Tables	
Table/ Appendix	Title
I	Individual/Crew Weapons Qualification
II	Leader Demolitions and Mine Qualification
III	Individual Demolitions and Mine Proficiency
IV	Individual Demolitions and Mine Qualification
V	Preliminary React to Contact
VI	Preliminary Training Course
VII	Intermediate Proficiency Course
VIII	Intermediate Qualification Course
IX	Advanced React to Contact
X	Advanced Training Course
XI	Advanced Proficiency Course
XII	Advanced Qualification Course
A	Metric Conversion Chart
B	Engineer Ammunition
C	Engineer Qualification Table Work Sheets

The Army's new standardized qualification tables for engineers will enable every unit to have the same level of training and readiness. For many years, the Engineer Branch has operated without a common single training standard for weapons, demolitions, and mines. The Armor and Infantry Branches have used qualification tables for over 25 years, which gave them a significant advantage for justifying ammunition, terrain, and range use.

The need for engineer qualification tables (EQTs) was established in the 1995 Senior Engineer Leader Training Conference. An ever-decreasing training budget and the increasing scope of employment and versatility of the force compounds this need. Breakout sessions held during the 1996 and 1997 Engineer Force (ENFORCE) Conferences established the framework for the EQTs.

Unit representatives from the ENFORCE sessions agreed that the U.S. Army Engineer School should create one set of tables to encompass all combat engineers, regardless of TO&E or component—*One Regiment, One Fight, One Set of Tables.* School personnel organized unit suggestions into twelve tables that mirror the Infantry and Armor gunnery tables. This design allows the three Army branches to speak the same language at training and resource meetings. The EQTs were then fielded to the entire engineer force for review, posted to the engineer home page, and reviewed at a 1997 ENFORCE breakout session. After those recommendations were incorporated, the revised version was staffed for review by engineer brigade commanders from selected engineer units. Final recommendations were incorporated in the EQTs and briefed to a council of colonels on 27 October 1997.

The new standardized EQTs permit sequential training and qualification of engineer units, progressing from individual to squad to platoon qualifications. Leaders are also qualified to ensure they are proficient at the tasks they will evaluate. The qualification process defines training readiness during mobilization, post mobilization, deployment, and sustainment at any location.

Squad and platoon tables contain foundation drills and tasks that combat engineer units must be able to accomplish to support maneuver forces during combined arms or joint operations. The unit commander can tailor the EQTs for the unit mission and the mission-essential task list (METL) by adding additional tasks and drills.

A combat scenario included in the EQTs is a vehicle for task execution. Embedded tasks are intended to be trained in this scenario or in a scenario created by the unit, as long as the tasks are directly linked to combined arms training strategies. While the scenario is not the only means of execution, it ties all tasks to the mission and allows effective use of training resources.

Authorization provided in DA Pamphlet 350-38, *Standards in Weapons Training* (Standards in Training Commission [STRAC]), is the basis of resource allocation for executing the tables. However, the EQTs are not constrained by those authorizations. Since the unit can tailor the EQTs to their METL and mission, ammunition use may vary. Appendix B is a feedback form designed to capture data and provide the Engineer School the amount of Classes IV and V materials used during the EQTs. The school will use data on these forms to justify future STRAC adjustments. Appendix C provides a method of recording the qualification status of individuals and units.

The final version of TC 5-150, *Engineer Qualification Tables,* is dated 16 June 1998. It is on the Engineer Center home page.

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Commissioned Officer Development and Career Management:

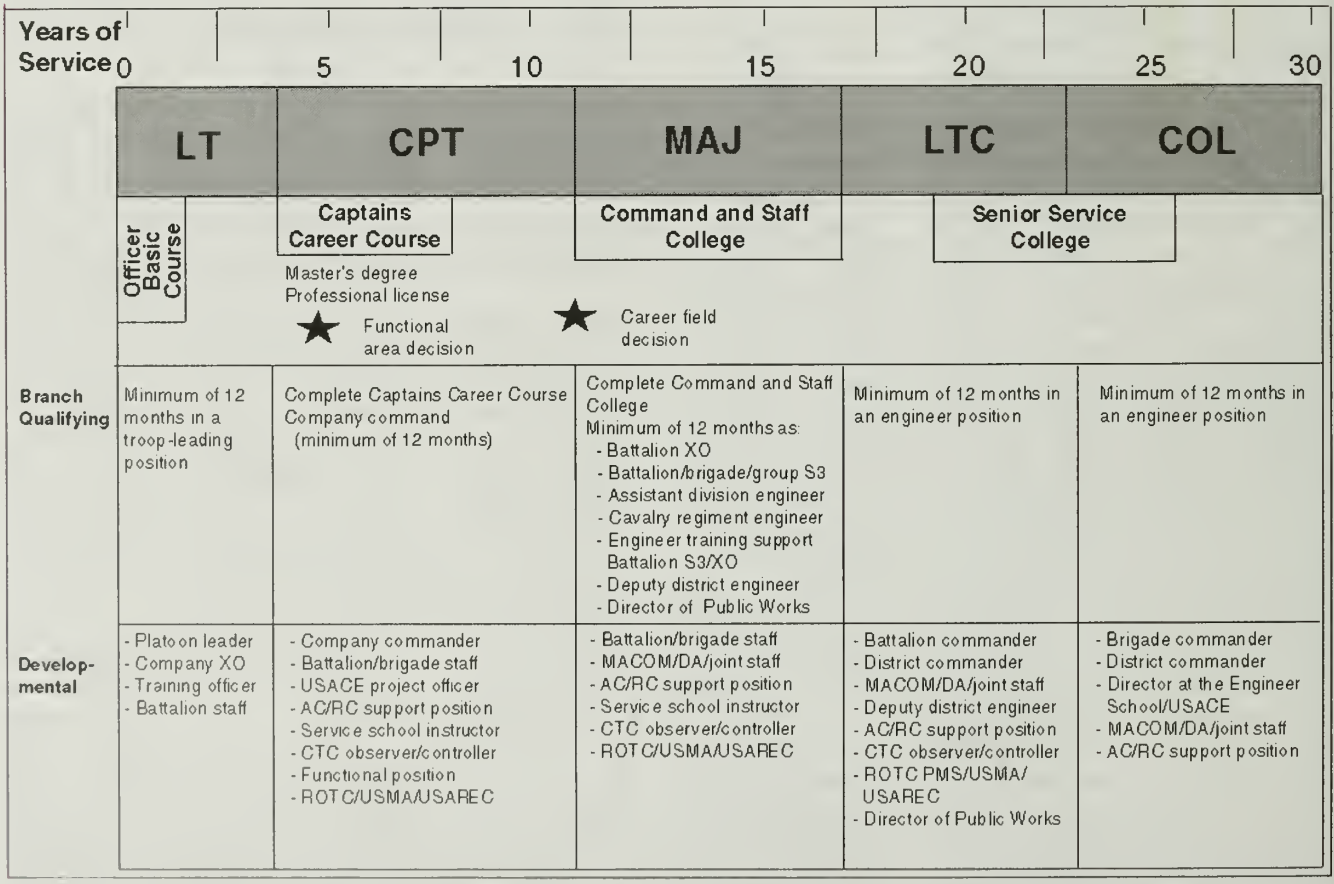
Engineer Chapter of DA Pam 600-3 Revised

By Major David Hartley and Captain Aaron Walter

Officer Personnel Management System (OPMS) XXI is a new officer professional development and management system designed to build an officer corps that will fulfill future needs of the Army and the nation. The revised Department of the Army Pamphlet 600-3 (DA Pam 600-3) addresses officer professional development and career management under OPMS XXI. Army officers will use it as a road map when making career decisions based on OPMS XXI. DA Pam 600-3 is scheduled for publication in October 1998, so that officers will have it before the new Career Field Designation (CFD) boards convene in FY99.

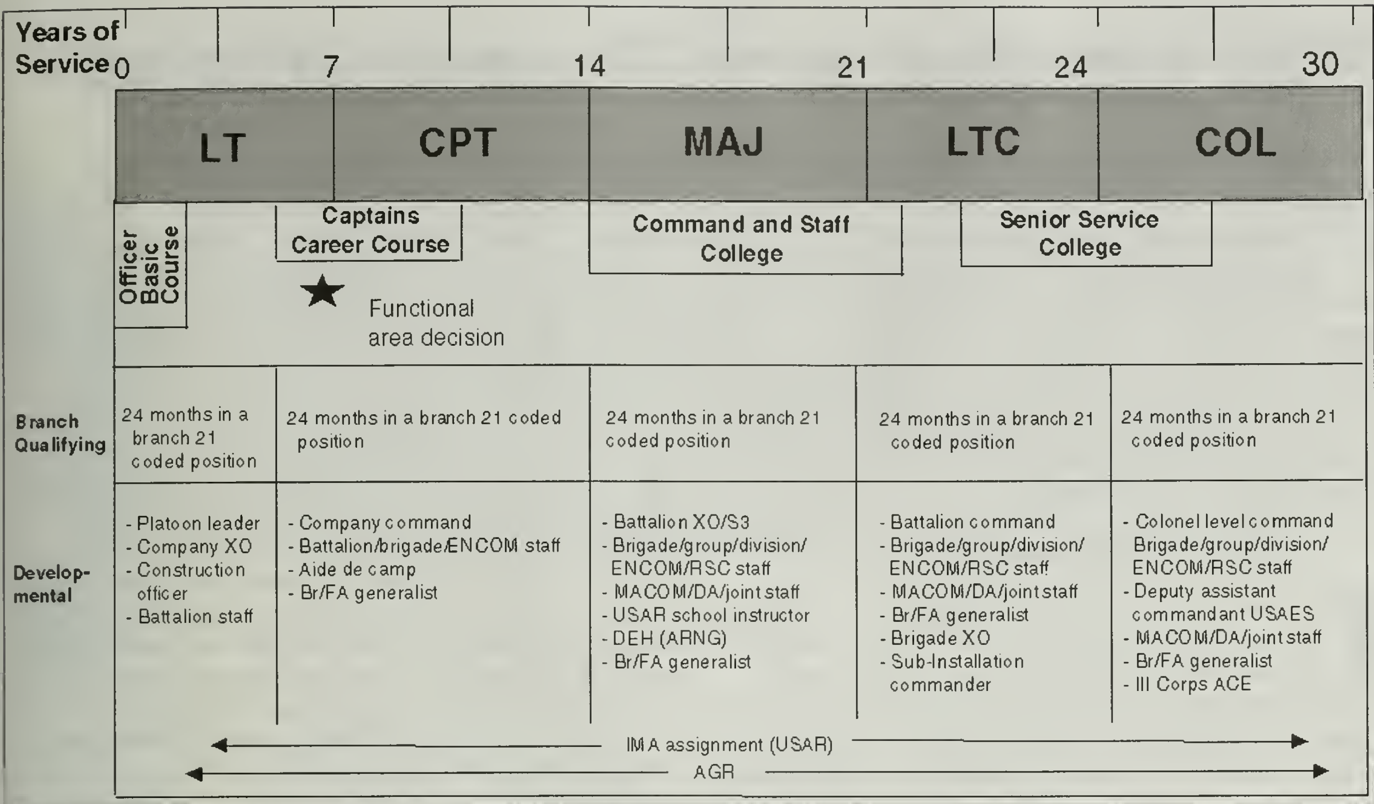
The Engineer Personnel Proponency Office (EPPO) submitted a revised Engineer chapter to update DA Pam 600-3 in February 1998. This chapter includes current features of the Engineer Branch, required officer characteristics, engineer officer development information, and an updated section on engineer Reserve Component (RC) officers. The Engineer chapter provided for the updated DA Pam 600-3 is available on the Fort Leonard Wood web site (www.wood.army.mil/EPPO/eppo_hp.htm).

Some of the most significant changes to the Engineer chapter pertain to engineer officer development. This section describes branch qualification, education, leader development and command preparation, and assignments for each grade. Figure 1, the Engineer Life Cycle Development Model (Active), highlights the redefined branch qualification requirements for each grade. Other changes include goals of



	LT	CPT	MAJ	LTC	COL
Branch Qualifying	Minimum of 12 months in a troop-leading position	Complete Captains Career Course Company command (minimum of 12 months)	Complete Command and Staff College Minimum of 12 months as: - Battalion XO - Battalion/brigade/group S3 - Assistant division engineer - Cavalry regiment engineer - Engineer training support Battalion S3/XO - Deputy district engineer - Director of Public Works	Minimum of 12 months in an engineer position	Minimum of 12 months in an engineer position
Develop-mental	- Platoon leader - Company XO - Training officer - Battalion staff	- Company commander - Battalion/brigade staff - USACE project officer - AC/RC support position - Service school instructor - CTC observer/controller - Functional position - ROTC/USMA/USAREC	- Battalion/brigade staff - MACOM/DA/joint staff - AC/RC support position - Service school instructor - CTC observer/controller - ROTC/USMA/USAREC	- Battalion commander - District commander - MACOM/DA/joint staff - Deputy district engineer - AC/RC support position - CTC observer/controller - ROTC PMS/USMA/USAREC - Director of Public Works	- Brigade commander - District commander - Director at the Engineer School/USACE - MACOM/DA/joint staff - AC/RC support position

Figure 1. Engineer Life Cycle Development Model (Active), from Figure 16-1 in DA Pam 600-3.



	LT	CPT	MAJ	LTC	COL
Branch Qualifying	24 months in a branch 21 coded position	24 months in a branch 21 coded position	24 months in a branch 21 coded position	24 months in a branch 21 coded position	24 months in a branch 21 coded position
Developmental	- Platoon leader - Company XO - Construction officer - Battalion staff	- Company command - Battalion/brigade/ENCOM staff - Aide de camp - Br/FA generalist	- Battalion XO/S3 - Brigade/group/division/ ENCOM/RSC staff - MACOM/DA/joint staff - USAR school instructor - DEH (ARNG) - Br/FA generalist	- Battalion command - Brigade/group/division/ ENCOM/RSC staff - MACOM/DA/joint staff - Br/FA generalist - Brigade XO - Sub-Installation commander	- Colonel level command Brigade/group/division/ ENCOM/RSC staff - Deputy assistant commandant USAES - MACOM/DA/joint staff - Br/FA generalist - III Corps ACE

Notes:

1. Must complete EOBC by second year (USAR) or 18 months (ARNG) of service.
2. Must complete a degree prior to promotion to captain.
3. Must complete EOAC by the 14th year of service.
4. Must complete CAS3 for promotion to major.
5. Must complete 50 percent of CSC for promotion to lieutenant colonel and then 100 percent within three years of promotion.
6. Must complete SSC for promotion to brigadier general.

Figure 2. Engineer Life Cycle Development Model (Reserve), from Figure 16-2 in DA Pam 600-3.

15 to 18 months in command for captains and 18 to 24 months in one of the listed positions for majors. These goals are desirable for leader development and unit cohesion, as defined in the leader development and command preparation sections for these two grades.

Several changes in the updated DA Pam pertain to RC engineer officers. These changes are shown in Figure 2, the Engineer Life Cycle Developmental Model (Reserve) (from the Engineer chapter), and are briefly described below:

- Officers must complete the Engineer Officer Basic Course (EOBC) by the second (not third) year of service.
- Officers must complete a bachelor's degree before promotion to captain.

The Engineer Officer Advanced Course (EOAC) and the Combined Arms Services Staff School (CAS3) have been integrated. The new course is called *Captains Career Course.* AC and some RC engineer officers attend an 18-week EOAC, which is immediately followed by six weeks of CAS3. Most RC engineer officers, however, will continue to attend EOAC and CAS3 in its current format until EOAC-RC is reconfigured and other details are worked out.

For more information on OPMS XXI, visit the OPMS XXI web site (www.army.mil/opms) or the AR-PERSCOM web site at (www.army.mil/usar/ar-perscom/ppo.htm).

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Who Are Engineer Warrant Officers?

By CW4 Clinton Parker, CW4 Fred Tressler, and CW4 Gilbert Rios

Perhaps the least understood soldiers in the U.S. Army are warrant officers, who are appointed by warrant of the Secretary of the Army. They are highly specialized experts and trainers who—by gaining progressive levels of expertise and leadership—operate, maintain, administer, and manage equipment, support activities, and technical systems throughout the Army's diverse branches. More than 25,000 active and reserve soldiers are warrant officers, who serve in specialties ranging from helicopter pilot through veterinary services technician to legal administrator.

Engineer Warrant Officers

The Corps of Engineers is the proponent for two warrant officer military occupational specialties (MOSs)—Utility Operation and Maintenance Technician (210A) and Terrain Analysis Technician (215D). Until October 1994, the Corps of Engineers was also proponent for the Engineer Equipment Repair Technician MOS (919A), but now engineers have only training responsibility for this MOS, and the Ordnance Corps has all other responsibilities. Table 1 shows the enlisted feeder MOSs for accession into these warrant officer MOSs.

About 80 percent of engineer warrant officers are in the Reserve Components, which consists of the Army National Guard (ARNG) and the U.S. Army Reserve (USAR). Their missions span the military and civil engineering spectrum.

Duties

Most positions in the three warrant officer MOSs are coded for particular grades. Specific duties for each grade are shown in Table 2, page 25.

MOS 210A

Utility Operation and Maintenance Technicians organize and manage personnel and organizations that provide engineer support on the battlefield and in rear areas. They plan, organize, and supervise the maintenance and repair of utilities equipment to support commanders engaged in real property maintenance activities, such as rehabilitating or remodeling and upgrading existing facilities. They maintain fixed or mobile electrical power plants (Prime Power Teams), install or set up deployable medical hospitals, and install and maintain high-voltage electrical power lines.

MOS 215D

Engineer Terrain Analysis Technicians provide geographic information in digital and hard-copy forms, so that maneuver commanders and staff elements can visualize the terrain and formulate possible courses of action early in the decision-making process.

MOS 919A

Engineer Equipment Repair Technicians manage, supervise, and coordinate general support maintenance activities for engineer equipment and direct maintenance and supply management operations. In staff positions, they assist and advise commanders in areas pertaining to maintenance and maintenance operations. They also serve as training implementers and developers, combat developers (equipment), and maintenance officers.

Opportunities

A career as a warrant officer offers rewarding opportunities for leadership and growth. It also demands great dedication and the highest moral character.

Warrant officer candidates must have above-average skills, demonstrated ability, and supervisory experience in a particular feeder MOS. Their highly specialized skills are warrant officers' most vital contribution. Civilian education and experience may substitute for some military training and experience.

In addition to MOS qualifications, warrant officers execute numerous managerial functions. They are expected to keep abreast of changes in equipment, organization, and procedures in their specialty.

Male or female NCOs, E5 or higher, may have what it takes to become a warrant officer. The Army's goal is to appoint NCOs with eight or fewer years of service in either the Active or Reserve Components as warrant officers. Applicants with concurrent orders to active duty should not exceed 12 years of active Federal service.

Table 1

Warrant Officer Accession Sources	
Warrant Officer MOS	**Enlisted Feeder MOS**
210A	51B Carpentry and Masonry Specialist
	51H Construction Engineering Supervisor
	51K Plumber
	51R Interior Electrician
	52C Utilities Equipment Repairer
	52D Power Generation Equipment Repairer
	52E Prime Power Production Specialist
	52G Transmission and Distribution Specialist (Reserve)
215D	81T Topographic Engineering Specialist
919A	52C Utilities Equipment Repairer
	52D Power Generation Equipment Repairer
	62B Construction Equipment Repairer

Table 2

Warrant Officer Duties	
MOS	Grade
210A	**WO1/CW2** ■ Assigned to combat support and evacuation hospitals. ■ Supervise organizational maintenance of wheeled vehicles, mobile medical support equipment, and utility power plants. ■ Repair, modify, and rehabilitate utility systems and subsystems, facilities, structures, power plants, station hospitals, and mobile hospitals. **CW3/CW4** ■ Command separate detachments that produce prime power. ■ Plan and supervise expedient vertical construction and rapid rehabilitation of structures, facilities, and utilities. ■ Repair interior and exterior of facilities (carpentry, masonry, plumbing, electrical work, and painting). ■ Plan, design, and contruct base camps. **CW5** ■ Serve as supervisor or advisory manager or in a staff position.
215D	**WO1/CW2** ■ Work at division level, usually as Terrain Analysis Detachment commanders. ■ Support the G2 on intelligence preparation of the battlefield. **CW3/CW4** ■ Serve on theater topographic battalion staffs, echelons above corps, and at major regional commands to help formulate topographic and terrain analysis requirements. ■ Serve as project officers at the Engineer School's Department of Training and Doctrine or Directorate of Combat Developments, where they develop engineer doctrine and identify mapping, charting, and geodesy requirements to support a mobile army in a digital environment. **CW5** ■ Work at the Topographic Engineering Center to help identify and coordinate research and development initiatives to meet the technical and automation needs of tomorrow.
919A	**WO1/CW2** ■ Assigned to engineer, ordnance, and transportation (terminal service) companies and battalions. ■ Supervise engineer and nonengineer equipment maintenance. ■ Oversee repair of equipment for power generation; earth moving, shaping, compacting, lifting, and loading; quarrying; rock crushing; road surfacing; refrigeration and air conditioning; and engineering electronic equipment. **CW3/CW4** ■ Assigned to engineer battalions and ordnance companies (heavy and light divisions). ■ Supervise organizational and direct support maintenance and staff responsibilities. ■ Supervise general support maintenance activites for engineer equipment. ■ Oversee repair of power generation, earth moving, refrigeration, air conditioning, and other engineer and nonengineer equipment. **CW5** ■ Serve in staff positions at brigade level or higher, assisting and advising commanders in areas pertaining to maintenance and maintenance operations. ■ Provide maintenance expertise in ordnance, engineer, airborne, and light and heavy divisional and nondivisional units.

Additional requirements are a high school diploma, a general technical score of 110 or higher, and an enlisted feeder MOS.

Warrant officer candidates must complete the Warrant Officer Candidate Course at Fort Rucker, Alabama, before attending the Warrant Officer Basic Course at Fort Leonard Wood, Missouri.

Army Regulation 611-112, *Manual of Warrant Officer Military Occupational Specialties,* Chapter 5, and Department of the Army Circular 601-94-1, *Warrant Officer Procurement Program,* provide detailed information on application procedures; or call CW4 Tressler at (573) 563-4088. To learn more about warrant officer history, visit the Warrant Officer web site at *http://leav-www.Army.mil/wocc.*

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CW4 Rios is a terrain analyst technician, U.S. Army Engineer School. A graduate of the Warrant Officer Staff and Advanced Courses, he holds a bachelor's degree from Austin Peay State University.

CW4 Tressler is the warrant officer coordinator in the Engineer Personnel Proponency Office, U.S. Army Engineer School. A graduate of the Warrant Officer Staff and Advanced Courses, he holds a bachelor's degree from Columbia College.

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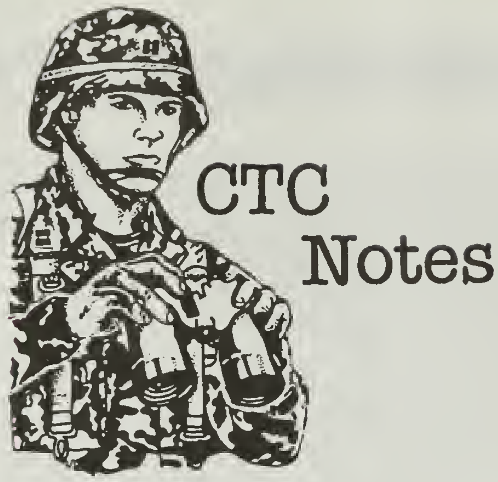

AIRBORNE

Joint Readiness Training Center (JRTC)

Survivability and Force Protection Operations in the Light Brigade Combat Team

By Captain John DeJarnette

Force protection operations are essential for a unit to be successful on the lethal, modern battlefield. Critical equipment and supplies must be protected from observation and attack. As stated in FM 5-103, *Survivability*, "Setting survivability priorities is a maneuver commander's decision based on the engineer's advice."

Units rotating through the JRTC typically struggle with planning and executing survivability and force protection operations. Most engineer planners do not clearly plan or effectively communicate their recommendations for survivability missions. Maneuver commanders generally do not place priority on the execution of survivability operations, and most soldiers and leaders do not know the standards for constructing individual and collective survivability positions. Guidance to help soldiers successfully plan and execute fortification and survivability operations follows.

Survivability Planning

Issue

Engineer company commanders and brigade engineers must prepare explicit plans for survivability operations and include this information in the brigade operations order. Omission of a clear, executable survivability plan is partly due to the lack of a clear doctrinal procedure for planning survivability operations at the brigade level. FM 5-7-30, *Brigade Engineer and Engineer Company Combat Operations*, thoroughly discusses the force protection planning process but does not provide sample survivability planning and execution products. Most engineer company leaders do not understand how to extrapolate the generic force protection planning process for tactical survivability operations. As a result, standard fortification priorities, work estimates, and sample planning and execution products are not included in their engineer and maneuver tactical standing operating procedures (TACSOPs).

Technique

Complete the following steps:

1. Identify all assets within the brigade. List the company-level organizations and major company assets in a matrix format. Explicitly state the command and control nodes, special signal equipment, major weapon systems, and high-value combat service support (CSS) assets that companies will control when they are task organized for operations. Include specialty units such as advanced trauma lifesaving teams, battalion mortars, combat trains, and forward aviation refuel/rearm points.

2. Prioritize the assets. Clearly state the priority of weapon systems within a given unit and the general priority of units.

3. Group the companies spatially as they will be arrayed on the battlefield. Recommended groupings are the brigade support area, forward logistics elements, forward aviation assembly areas, artillery batteries, tactical operations centers, the maneuver battalion, and signal nodes.

4. Prepare work estimates for the protective systems required to counter the anticipated threat. Consider preparing estimates to address three general threat levels. For example, Level I generally addresses subversives and criminals capable of small arms direct fire and mortar attack; Level II focuses on the addition of terrorists capable of stationary and moving vehicle bombs; and Level III addresses direct attack by a company-sized or larger element with cannon artillery indirect fire capability.

The resultant planning matrices are a useful reference for unit TACSOPs and initial force protection planning. The threat evaluation and the commander's priorities are then incorporated into the survivability execution time line prepared by the engineer company. Survivability priorities for each weapon system and unit must be included in the maneuver brigade and battalion base operation orders to avoid conflicts when the force protection plan is executed.

Survivability Missions

Issue

Maneuver commanders must establish clear command and control of engineer digging assets and aggressively monitor execution of the fortification plan. Maneuver and CSS battalions typically appoint a maneuver leader as "CINC Dozer" only during deliberate defensive operations. During offensive, stability, and support actions, the engineer equipment platoon leader often must decide how to execute the brigade fortification plan. When command and control is inadequate for the brigade force protection effort, several problems may emerge:

- ❑ The engineer unit and the customer unit fail to coordinate their work efforts before the blades arrive at the supported unit. This situation occurs when survivability sections in unit TACSOPs are poorly written and when units do not associate habitually during routine field training.
- ❑ Engineer equipment supervisors are not integrated into the advance parties of the supported unit. As a result, the supported unit receives no technical advice on how to site and mark survivability and protective positions. Inadequate coordination early in an operation results in wasted time and effort for both the customer and the engineer and inefficient use of engineer equipment. Drainage is a critical task that generally is not addressed and often is omitted when engineers are not part of the supported unit quartering party. The cumulative result of poor engineer integration is unnecessary disruption of the supported unit's operations in order to construct appropriate fortifications.
- ❑ When construction standards are not well documented, the engineer equipment supervisor usually receives conflicting guidance from the supported unit's first sergeant, the unit commander, and supported unit equipment crews. Poor coordination almost always results in wasted blade time and considerable frustration for both the engineer and supported unit leaders.

Technique

- ❑ Each customer unit should appoint a senior leader as "CINC Dozer." Establish graphic control measures such as logistics release points, checkpoints, or coordination points where engineer equipment teams will link with supported units.
- ❑ Coordinate early and train habitually with supported units to establish shared expectations.
- ❑ Document unit fortification requirements in the TACSOPs. Engineer equipment supervisors routinely should be part of the advance party of the supported unit to ensure that survivability positions are marked before the engineer and supported unit equipment arrives. This practice allows the supporting engineer unit to prepare fortifications before the main body of the customer unit arrives. It also allows the supported unit's chain of command to verify the overall layout of the unit's position.

Issue

Security of blade teams during movement is a continuing problem. Most maneuver brigades require the supported unit to provide security when this equipment is moved to battle positions or assembly areas. While this technique seems logical during a briefing, it is extremely difficult to execute. Because CSS units and infantry rifle companies lack vehicles with mounted weapons to escort the blade teams, engineer equipment frequently moves around the battlefield without escort or security. As a result, engineer equipment is frequently lost, damaged, or destroyed, and the brigade's fortification effort is significantly delayed.

Technique

The maneuver commander should dedicate a security element to escort engineer equipment to work sites. The security element should come from either the Delta Company of an infantry battalion or a Military Police section. Ensure that both the customer unit's "CINC Dozer" and the security escort unit know where and when to link up. Clearly state radio frequencies and call signs for link-up operations in the fragmentary order or operations order that directs survivability operations. Consider using existing CSS or maneuver graphic-control measures such as logistics-release points, traffic-control points, or coordination points as link-up locations for engineer equipment.

Construction Standards

Issue

Both engineer equipment operators and supported unit leaders must clearly understand fortification and digging standards. Because most maneuver leaders are not well versed in survivability construction standards, protective positions generally are substandard. Overhead cover and bunkers rarely are constructed to standard. Some are unsafe because soldiers don't know the construction standards and leaders don't check construction quality.

Technique

Document survivability position standards in brigade, battalion, and company TACSOPs. Require that both supporting engineer unit leaders and supported unit leaders inspect the construction standards of survivability positions. Quality-control inspections are particularly important for equipment not covered in FM 5-103, such as air-defense and fire-finder radar, signal intelligence equipment, and mobile subscriber equipment vans.

Battle Tracking

Issue

Maneuver commanders and their staffs must aggressively monitor the execution of force protection plans. When the survivability effort is not closely tracked, critical assets may be unprotected for long periods and survivability operations may react only to enemy events. When maneuver commanders are unaware of delays in survivability construction, they cannot adjust work and equipment priorities to support their main effort.

Technique

Include survivability levels and work priorities in the unit TACSOPs. Task force and brigade engineers should brief the execution status of the survivability construction effort daily at the commander's update.

Summary

Fortification and force protection operations at the Joint Readiness Training Center historically have not been well planned or well executed. Units can reverse this trend by applying the force protection planning process and by incorporating standard survivability planning and execution products in their unit SOPs.

Captain DeJarnette is the Engineer Company Observer/Controller at the Joint Readiness Training Center, Fort Polk, Louisiana.

Battle Command Training Program (BCTP)

Obstacle-Control Measures as a Synchronization Tool

By Lieutenant Colonel Ron Light

In the August 1997 issue of *Engineer* (page 42), LTC Dave Snodgrass discusses obstacle-control measures and effect intents. This excellent article is worth review, particularly for those serving at corps or division levels. In the article, LTC Snodgrass notes that all unit staff officers are familiar with obstacle-control measures, but few of them effectively use the obstacle zones and effect intents.

Recent BCTP Warfighter exercises indicate this inefficiency remains. Engineer staff officers fail to synchronize the mobility and survivability battlefield operating system (BOS) with the maneuver plan, especially during defensive operations. Engineers usually could achieve greater synchronization through the judicious use of obstacle-control measures and effect intents. The following information continues the discussion of how to improve synchronization of the engineer effort with the maneuver plan. I focus on division-level operations, although the lessons are essentially the same for engineer staff officers at corps, division, or brigade levels.

FM 5-71-100, *Division Engineer Combat Operations*, lists three obstacle-control principles that can help engineer staffs achieve synchronization. Obstacle zone planning is guided by these principles:

- Support the division commander's intent and scheme of maneuver.
- Balance maximum flexibility versus a focused obstacle effort.
- Facilitate future operations.

Let's examine these principles to assess how engineers can increase synchronization.

Support the Commander's Intent and Scheme of Maneuver

Engineers must understand the commander's intent and scheme of maneuver, specifically *where the commander wants to kill the enemy and how he wants to shape the battlefield.* Commanders and staffs often complete the military decision-making process (MDMP), but neither the base order nor the engineer annex address a cohesive, division-wide effort to shape the battlefield. Engineer staff officers must press the commander for these details.

Obstacle-zone and effect-intent graphics provide a doctrinal method to convey a common picture showing how the commander wants to shape the battlefield. Most commanders understand the obstacle effects of disrupt, fix, turn, and block. Use of obstacle-zone and effect-intent graphics allows the commander to determine if his plan will shape the battlefield in accordance with his vision and if the engineer effort is synchronized with the scheme of maneuver. These graphics help answer the following kinds of questions: Did we plan to turn the enemy into this high-speed avenue of approach? Do we really want to turn the enemy into this supporting-effort brigade? Do we have enough time and materiel to block the enemy across the entire division zone, and how will he react to that? Is my counterattack route free of friendly obstacles?

Doctrine does not require that the division commander use obstacle-zone and effect-intent graphics. The commander can specify how he wants to shape the battlefield and where he wants to kill the enemy in the intent narrative or in the scheme of maneuver. This rarely occurs, and when units attempt a narrative, it is often long and confusing. A simple graphic showing obstacle zones and effect intents can convey more than several paragraphs of text. Whichever method is used, the *entire division*—all staff officers and all subordinate units—must clearly understand how the commander wants to shape the battlefield. This is where synchronization starts.

Balance Flexibility Versus Focused Obstacle Effort

Experience gained at Warfighter exercises suggests that the engineer effort is not synchronized with the scheme of maneuver due to too much flexibility rather than too much control. In a desire to provide brigades with maximum flexibility, the commander and his staff often underprescribe obstacle-control measures and effect intents. The division engineer and his staff do not *focus* the division obstacle effort. The overall intents for division obstacle zones are left to subordinate brigades.

The lack of engineer focus also affects other staff areas. The staff engineer and the division G4 often allocate resources (such as Volcano systems and Class IV/V obstacle materials) to brigades in a way that does not support the scheme of maneuver. In an effort to be strong everywhere the unit ends up being strong nowhere, and mass is not achieved. To achieve a balance between obstacle control and subordinate unit flexibility is an art. Doctrine admonishes us to "get ahead of the enemy's decision cycle." Greater control—through the use of obstacle effect and intent graphics—makes sense on a dynamic battlefield where the staff must consider an end state that supports future operations.

Facilitate Future Operations

Effective use of obstacle-control measures facilitates future operations. Ineffective obstacle-control measures often result in disaster and chaos. Without a clear understanding of how the scheme of maneuver and obstacle plan "nest" within their higher headquarters' missions, subordinate unit leaders plan and conduct their fights independently. Brigades construct obstacles without regard to division-level counterattack routes or main supply routes. Self-destruct times for scatterable mines are not synchronized with the division plan. The division does not achieve the principles of war of mass, economy of force, offensive, and unity of command, because each succeeding echelon's concept of the operation is not nested in the other.

Obstacle-control measures should support future operations while *maintaining a degree of flexibility for the commander.* This is true for both offensive and defensive operations, which is a fact most engineer staff planners overlook. Just as engineers should plan a breach operation from the objective back to the line of departure, obstacle-control measures should support the operation from the end state of at least each phase of an operation back to the beginning of that phase.

When engineers fail to apply the three obstacle-control principles, the results are predictable: Without a clear understanding of how they are to shape the battlefield, subordinate units fight their sectors with little regard to the overall division fight. Other staff officers do not effectively weight their BOS to achieve mass. When the enemy's main effort becomes clear to the division, the commander is unable to defeat the attacker because the maneuver units cannot mass and counterattack routes are impassable. The enemy then defeats the maneuver brigades one at a time.

By using obstacle-control measures effectively, we can improve our ability to synchronize engineer operations with the scheme of maneuver. The obstacle-control principles listed in FM 5-71-100 provide division engineers and their staffs with a test of countermobility plans: Does my plan support the commander's intent and scheme of maneuver? Is it evident to subordinate units where and how the commander wants to shape the battlefield and kill the enemy? Does the plan provide for future operations? Evaluate your plan against these principles and METT-T, and determine if the engineer plan is synchronized with the scheme of maneuver. This evaluation allows you to gain a proper balance between obstacle-control measures and subordinate unit flexibility, and it will show the degree to which you must utilize obstacle-control measures.

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National Training Center (NTC)

Increasing ABE Proficiency

By Captain Shawn McGinley

Recent rotations at the NTC have shown that the majority of assistant brigade engineers (ABEs), while working hard and accomplishing some great things, have been unable to fully develop themselves or their sections in providing continuous mobility and survivability support. Part of the problem is the lack of a mission training plan (MTP) that addresses tasks an ABE must accomplish. The only reference is the 1989 version of the Headquarters and Headquarters Company, Engineer Battalion, Heavy Division MTP.

Observations from past rotations have shown that to be proficient in their duties, ABEs must accomplish the following tasks for each mission:

- The engineer battlefield assessment (EBA)
- Terrain analysis
- Situational obstacle planning
- Engineer-related input to the brigade combat team (BCT) order

Observations and recommended solutions follow.

Engineer Battlefield Assessment

Observation

- Most ABEs are proficient in the elements that make up the EBA but seldom complete them due to poor time management skills. Many units train using computer simulations and are unprepared for the battlefield friction the NTC imposes on them.

Recommendations

- ABE sections and engineer battalion plans sections must incorporate time constraints, battlefield friction, and stresses of continuous operations in their home station training.
- Units should prepare detailed standing operating procedures (SOPs) that include the distribution of labor within the ABE and engineer battalion plans sections.
- Units should cross train all members of the ABE and engineer battalion plans sections to increase their flexibility.

Terrain Analysis

Observations

- The brigade staff does not appreciate how significantly terrain will impact BCT operations.
- Many ABEs brief terrain only in general terms (mountain high, valley low) and fail to discuss OCOKA (observation and fire, cover and concealment, obstacles, key terrain, and avenues of approach).
- Mission-specific terrain products are produced too late to assist the BCT and task-force-level planning.

Recommendations

- The BCT staff must allow sufficient time during the military decision-making process (MDMP) for the ABE to brief the impacts of terrain in detail.
- The ABE section must anticipate mission-specific requirements and produce terrain products early in the planning process.
- Everyone in the ABE section must be proficient in using TerraBase II software.

Situational Obstacle Planning

Observations

- The brigade staff plans situational obstacles only where the BCT expects to make decisive contact with the enemy.
- ABE and BCT staffs do not synchronize the observer and trigger plan for employing situational obstacles.
- The ABE section assigns engineer companies “mission impossible” situational obstacle tasks.

Recommendations

- Situational obstacles must be planned throughout the depth and width of the BCT zone. The enemy may not do what we want him to do!
- The observer must see the trigger (TerraBase II software helps with this). If he cannot, the observer must move, another observer must be put into position, or the BCT should forget about that planned situational obstacle.
- All planned, brigade-level situational obstacles should be war-gamed during the MDMP. The BCT staff must address the feasibility of employing situational obstacles based on the enemy situation and the employment system.

Engineer-Related Input to the BCT Order

Observations

- ☐ BCT base orders lack engineer-specific details to assist the BCT with executing missions.
- ☐ Brigade S3s do not allow ABEs to include critical engineer-related tasks—specifically subunit and coordinating instructions—in the base order.
- ☐ Many BCT subunits receive the brigade order but fail to read the engineer annex. Thus, the subunits do not accomplish critical engineer-related BCT tasks listed in the engineer annex.
- ☐ BCT orders rarely include survivability and countermobility time lines.

Recommendations

- ☐ Engineer battalion leaders must ensure that home station training for BCT staffs focuses on including critical engineer-related tasks in the BCT base order.
- ☐ The BCT order must include survivability and countermobility time lines to facilitate task-force-level planning.

Information in this article will help assistant brigade engineers as they plan home station training strategies. It does not describe all of the many tasks ABE sections must accomplish. While the ABE position may be deleted in future engineer battalion tables of organization and equipment, the mobility and survivability tasks discussed above will not go away. Therefore, engineer battalions must plan to do more with less. The above recommendations will help ensure that engineers provide quality mobility and survivability support and remain an integral part of the brigade combined arms team.

Captain McGinley is attending the College of Naval Command and Staff. He served as an observer/controller at the National Training Center, Fort Irwin, California, from 1996 to 1998.

MANEUVER SUPPORT BATTLE LAB NEWS

Soldiers from B Company, 5th Engineers, recently wear tested a new, lightweight chemical protective textile material at Fort Carson. B Company soldiers conducted mobility, countermobility, and survivability operations in support of 1/3 ACR.

SP4 Reyes conducts preventive maintenance checks and services during the chemical protective combat uniform wear test.

Two soldiers from 2d Platoon, B Company, emplace a picket during the test.

Sidewinder Team Situation Report

By Lieutenant Colonel Richard Graves

Units rotating through the National Training Center (NTC) may have noticed several changes in the way brigade combat teams (BCTs) and their engineer battalions execute training missions. While none of the changes are revolutionary, collectively they substantially improve the quality and realism of training. Some changes contradict current rules of engagement, and many are innovations developed by units at home station and "tried out" during their NTC rotation. We provide the following information to units during their Leader Training Program and present it here to assist leaders as they develop their home-station training.

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Training Scenario

The Opposing Force is still the toughest enemy in the world, bar none. We have not changed the traditional mix of five force-on-force fights and two live-fire missions, with their usual assortment of attacks, movements to contact, and defense in sectors. The observer/controller (OC) and the platoon and company after-action review process are still the heart and soul of the NTC. The Sidewinder Team continues to provide as many instrumented battalion after-action reviews as possible, with focused reviews based on unit requests or OC recommendations.

What has changed for some BCTs is the addition of one to three days of division-directed rehearsals (DDRs) at the beginning of a rotation. DDRs are OC-directed situational training exercises (lane training), with the first day being platoon-level events and the second and third days company team and task force combined-arms events, respectively. First-day DDRs conducted by the Sidewinder Team include tasks from the engineer qualification tables. If your BCT plans to execute DDRs in either format, we suggest you coordinate early with the Sidewinder Team to establish a lane composition that meets your training objectives.

Another change to recent rotations is the inclusion of one or more flex missions in the scenario. These missions are BCT flexibility "gut checks." With from zero to 12 hours notice before execution, the BCT's higher headquarters—the 52d Mechanized Infantry Division—passes a fragmentary order to expand or contract boundaries, change objective locations, or even change the entire mission.

In addition to the normal planning requirements, we suggest that units assemble checklists of planning, preparing, and executing considerations for all likely missions before the rotation.

Training Realism

As a secondary role, OCs provide realistic battlefield effects. We have made several changes to better replicate expected battlefield effects and help units meet their training objectives. For example, we reintroduced the mine effects simulator (MES) for both the Blue and Opposing Forces. When the magnetic field of the MES is disturbed, it sends a pulse that kills all MILES II-equipped personnel and vehicles within its 10-meter killing radius. Employment requires an extra step—shunting two contacts on the

MES—but the payback is a more robust minefield obstacle.

The NTC has long been behind the times with respect to demolition effects simulators (DES). The rules of engagement allow DES on an exceptional basis. However, the NTC Standards in Training Commission (STRAC) Table 10-3 allocation for live-fire Class V materials does not provide enough detonation cord for breaching operations, much less DES construction. The Fort Irwin Training Support Center (TSC) does not stock the necessary cardboard tubes, clay, chalk, etc., so training units are not inclined to use DES.

Engineer battalions have successfully overcome these obstacles and learned that constructing and employing DES substantially improves force-on-force realism. The units used Class V materials allocated for live fire, but with a little planning, they can transfer sufficient Class V materials from their home-station to the NTC for this purpose. For a long-term fix, the Sidewinder Team is working with the TSC to procure the construction materials. The team is also working to change the STRAC allocation to provide more Class V materials for breaching and DES and to include modernized demolition initiators (MDIs). Until the STRAC allocation is changed, units can either transfer MDI from the home station to the NTC or conduct conventional initiating systems training at home station to prepare for their rotation.

Another success story involves improvements in scatterable mine employment. The NTC no longer categorically denies unit requests for additional situational obstacle capabilities and longer-duration self-destruct times. Each request is considered on its own merit and unit training objectives. The 52d Mechanized Division engineer reviews the mission, enemy, terrain, troops, and time available (METT-T) conditions before reallocating scarce Class V resources within the division, asking X Corps for additional resources, or granting longer self-destruct times.

Training Innovations

Most battalions bring to the NTC a unique organization, piece of equipment, or tactics, techniques, and procedures (TTP) developed at home station and expect to see how the concept fights. In the past year we have tested several variations of the consolidated blade and Volcano platoon concepts. Centralizing command and control, maintenance, and mission execution need not reduce flexibility or support to maneuver commanders, but this can't be determined solely by reading a manual. The best techniques usually are developed while units execute engineer missions.

Engineer reconnaissance is another task we have tried to improve this year. Engineer-specific intelligence often is poorly collected and disseminated or may not exist. One solution is to attach individuals or teams of sappers to a BCT or to task force scouts. Another option is for independent engineer reconnaissance teams to work for the engineer battalion S2. Most reconnaissance methods achieve some measure of success, and all of them provide training for the commander, staff, and sappers that is attainable only at the NTC.

Some units attach explosive ordnance disposal (EOD) teams or EOD companies to engineer battalions. This is a nondoctrinal solution to the EOD command and control problem (little doctrine exists). Historical precedence for this practice was set in Bosnia by the 1st Armored Division Engineer Brigade. In previous years at the NTC, EOD teams were attached to the forward support battalion in the brigade support area (BSA), with most of their "business" in the BSA. With that configuration, the EOD combat multiplier was seen and felt only on a small portion of the battlefield, and the rest of the BCT received little unexploded ordnance (UXO) procedures training.

With the engineer battalion focused on mobility, and with engineer command and control nodes spread across the entire battlespace from the BSA to the breach site, engineers are the best candidates for integrating EOD teams. Attaching the teams to the engineer battalion achieves a number of important training objectives:

- The BCT develops procedures to identify, report, and track UXO.
- The engineer battalion exercises command and control of attached units.
- The EOD company and team perform missions safely in a tactical environment.

Creating a UXO-rich training environment that more closely replicates wartime hazards and effects on mobility further enhances UXO training.

Conclusion

These innovations, and many we have not heard of yet, have a place at the NTC. Units are not penalized for attacking age-old problems, but solutions may be difficult in this era of ever-dwindling resources. FORSCOM/TRADOC Regulation 350-50-1, *Training at the National Training Center,* is fairly definitive about what units can do. However, requests for exceptions can be sent to the NTC by letter 180 days before the rotation. The Sidewinder Team will help as much as possible with obtaining exceptions and may even be able to provide some TTP ideas. Contact the team by e-mail or though the Sidewinder home page at http://www.irwin.army.mil/sidewinder. The site provides slides used for Leadership Training Program classes on obstacle integration and deliberate breach planning and other items.

Lieutenant Colonel Graves is the Deputy Senior Engineer Battalion Trainer at the National Training Center, Fort Irwin, California. He previously served as chief of the Doctrine Development Division, U.S. Army Engineer School.

Safety Compliance Training

By Major Scotty DeClue and Captain Glenn Gamlin

Ask anyone, in any organization, if he or she believes safety is important, and all will agree that it's one of the most important topics in the workplace. One might ask, "If everyone believes safety is so important, why should we perform safety compliance assessments?" The answer is that not everyone fully understands the safety rules or follows the published rules. *"Safety Rules"* are derived from 29 CFR (Code of Federal Regulations). These legal guides provide specifications for safe operations for people using chemicals or electrical and lifting equipment or who are involved with industrial activities.

The 416th Engineers conduct total facilities assessments (TFAs) at U.S. Army Reserve (USAR) facilities across the continental United States and overseas. The TFA includes an Environmental Compliance Assessment, a Facility Safety Assessment, an Energy Assessment, and a Facility Condition Assessment. The following information describes how to design, develop, and implement a Facility Safety Assessment training program for USAR soldiers.

Members of the USAR environmental staff and the 416th Engineers have taught an Environmental Compliance Assessment System (ECAS) training course for several years. As a result of this training, the USAR staff consistently produce high-quality environmental assessment reports, which help us achieve or maintain compliance with numerous environmental laws. Funding for a comparable safety compliance course was not available in 1997, so we developed the Facility Safety Assessment training course to help soldiers identify safety deficiencies.

Common OSHA* Violations

Circuit breakers must be properly labeled.

Electrical outlets within 6 feet of wet areas must have ground fault circuit interupters, as shown at left.

Live electrical equipment operating at 50 volts or more must be enlosed in a metal container.

* Occupational Safety and Health Administration

The Program

To prepare the program, we followed the five-step Systematic Approach to Training (SAT) process: Analyze, design, develop, implement, and evaluate.

Analyze. First, we conducted a needs analysis to determine if the training is required and can correct a deficiency. The 416th Engineers designated Safety Assessments as the number 2 priority after Environmental Compliance Assessments. Job and task analyses are part of this step. Conducting a Facility Safety Assessment is within the scope of the Facility Engineer Team, but its safety checklist (provided by the USAR Command [USARC] Safety Office) is only a list of potential impacts at USAR facilities. The checklist does not describe how to evaluate safety items to determine compliance versus noncompliance, nor does it provide a means to take corrective action on items identified as deficiencies. This information is needed to identify and correct safety deficiencies within USAR facilities.

Design. During this step, we wrote the *Facility Safety Assessment Guide.* We reviewed FY96 safety checklists to identify common deficiencies and verify requirements in 29 CFR. Then, using the ECAS format as a guide, we developed a "safety finding sheet." This sheet states the requirement, specific legal references, and information the assessor must check. Deficiencies are listed individually. The format is a significant improvement over the safety checklist because it describes the deficiencies in detail. We used information on the safety findings sheet to develop learning objectives and establish criteria for the performance-based evaluation.

Develop. During visits to several USAR facilities, we took photographs depicting safety deficiencies and prepared slides and overhead transparencies to support class discussions (see photos, page 34). We wrote a lesson plan to identify and correlate deficiencies and to present the training in a logical sequence.

Implement. We scheduled a classroom, coordinated use of a USAR facility for the field training exercise, prepared an agenda, and advertised the course, which has five phases: lecture, practical exercise, field training exercise, report preparation, and findings briefing. Then we conducted a practice session to validate that objectives were met and the level of instruction was appropriate.

Evaluate. The course has been evaluated several times to date, but this step is ongoing. Students evaluate the course at the end of every session to determine strong and weak points and if they feel it prepares them to conduct Facility Safety Assessments. They complete a second survey six months later to determine their retention of course content and if they have experienced difficulty conducting Facility Safety Assessments. The USARC Regional Support Commands, the USARC Safety Office, and USAR facility managers will evaluate the 416th Engineers' Facility Safety Assessments at the end of FY98. By identifying common deficiencies and corrective actions, the 416th intends to publish lessons learned to assist facility managers when they conduct self-assessments to improve their safety posture.

Benefits

We conservatively estimate that our initiative to design, develop, and implement the safety training program saved the 416th Engineers more than $150,000 in FY97. This figure is based on an estimate of current professional consulting rates and the hours we spent developing the course. By having Army Reserve soldiers conduct this training (versus professional consultants), we project annual savings in excess of $100,000. The USARC spent about $30,000 for a 2-day training course in 1996. We plan to conduct four 2-day Facility Safety Assessment training courses in FY99 on drill weekends instead of using annual training days.

The true measure of our success is not whether the 416th Engineers can produce excellent Facility Safety Assessment reports but if, through our efforts, USARC facilities are a *safer* place for soldiers and civilians to work. We believe that base camps in forward areas can use our facility safety assessment format to evaluate their safety compliance programs. The program we developed will reduce the number of noncombat injuries and assist the overall mission accomplishment of any operation.

Major Scotty C. DeClue, a registered environmental manger and certified environmental trainer, serves as the Technical Training Program Administrator for the Department of Energy's Savannah River Site in Aiken, South Carolina.

Captain J. Glenn Gamlin, a certified safety professional and hazardous materials manager, works as the Safety/ Environmental Manager for Cummins Diesel Recon Company in Memphis, Tennessee.

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Improving Digitized Engineer Communications

By Captain Daniel R. Smith

The Army has pushed its advanced guard into the 21st century. The past decade has seen extensive experimentation at all levels, with the concept of a computerized (or digitized) Army of the future. Units involved in these experiments are known as Task Force XXI.

Recently, I served as supply officer (S4) and senior battle captain in the engineer battalion Administration and Logistics Center (ALOC) during the Task Force XXI Advanced Warfighting Experiment. For the 299th Engineer Battalion and the rest of 1st Brigade Combat Team, 4th Infantry Division, the AWE was much more than a two-month exercise in the desert. It was an 18-month learning experience. The daily lessons learned, problems solved, and challenges met provided Army soldiers, numerous defense contractors, and our senior leaders with valuable feedback to use in charting our course into the future. Ironically, communications—the very thing Force XXI was supposed to improve and the lifeblood of any tactical operations center (TOC)—became our biggest challenge. This article discusses four communications problems experienced by the 299th Engineer Battalion S1/S4 section and recommends some possible solutions.

Communications Problems

The experiment was conducted through a train-up and brigade-level training rotation in March 1997 at the National Training Center, Fort Irwin, California. Preceding the train-up were various computer instruction classes, computer equipment installations (known as *appliqué*), and new equipment training to familiarize leaders and soldiers with initiatives we were expected to use and test in simulated combat operations.

Numerous problems plagued our communications. Most grew out of the contractors' misunderstanding of engineer logistical operations and communications requirements and how they differ from maneuver logistical operations and communications requirements. Like other members of the brigade, we in the engineer battalion ALOC faced a myriad of technical, training, and architectural problems with the tactical internet and other experimental initiatives.

Problem: *Digital message traffic between the ALOC and specific engineer vehicles, which was essential to combat service support (CSS) execution, was virtually nonexistent.*

Officers of the 299th Engineer Battalion (Task Force XXI)

There was no digital message traffic between engineer company first sergeants or TOCs and the engineer battalion ALOC. The command sergeant major, the three company first sergeants, and each company TOC continually sent appliqué messages to the ALOC from their respective vehicles (known as platforms), but the messages never arrived. Digitized message acknowledgment logs inside the appliqué showed neither a machine acknowledgment of nor an operator response to the messages.

Possible operator training and/or communications and maintenance problems were exhaustively investigated and corrected when necessary, but we determined that they weren't the main problem. Continued investigation showed that the digital messages had to move through other platforms called *servers* or *nodes* to get from one vehicle's appliqué to another's. If a message had to "hop" through more than four nodes, it disappeared.

Lacking understanding of engineer operations, the contractor had arranged the vehicles in the tactical internet so if engineers tried to send a message to the battalion ALOC from one of the vehicles, the message almost always had to pass through more than four nodes. In addition, whenever a server became overloaded with digital traffic, messages reaching that server were ignored and disappeared. While a few messages were received, digital message communications

A soldier shows the appliqué inside his vehicle.

from each of the platforms remained inconsistent and unreliable.

Recommendation: *Continue to investigate the software for problems and revise the architecture so that the engineer command sergeant major, company first sergeants, and TOCs have a direct route for messages to the ALOC.*

With few exceptions, engineer units must maintain effective communications with maneuver command and logistics nodes as well as with their parent battalion's command and logistics nodes. It is essential that digital systems allow the company to communicate as effectively with the engineer battalion ALOC as it does with the task force.

Problem: *The modified table of equipment (MTOE) and appliqué architecture allocate an insufficient number of radios to the ALOC to monitor all essential nets.*

The MTOE allocates the engineer battalion ALOC only two radios. The appliqué architecture forces the ALOC to use those radios to monitor only the engineer battalion administration and logistics (A&L) net and the forward support battalion (FSB) A&L net. This architecture is not tactically sound for several reasons. First, the FSB conducts command and control (C2) and all other business on the FSB command net, not on the FSB A&L net. Therefore, the engineer battalion ALOC is out of the loop and does not receive essential information. Examples of missed information are enemy contact reports in the brigade support area (BSA), jump or movement C2, changes in the mandatory operational protective posture (MOPP) level, air defense artillery status, and all net calls. As a member/tenant of the BSA, the engineer battalion ALOC must monitor the FSB command net, not the FSB A&L net.

Second, current architecture does not allow the ALOC to monitor the engineer battalion command net. The ALOC is a battalion command post and an alternate TOC for the battalion TOC. Thus, the ALOC needs the capability to monitor, track, and C2 engineer combat operations. The A&L net is not effective for this purpose because the architecture dictates that the only platforms on that net are the ALOC, the company first sergeants, the command sergeant major, the support platoon, and the headquarters company commander. The architecture does not allow the Maneuver Support Company a single radio on the A&L net. If the ALOC could monitor the battalion command net, it would have voice communications with the battalion and company TOCs and commanders, which would facilitate battle and CSS tracking. A third radio is needed so the ALOC can monitor the engineer battalion command net.

Third, current architecture doesn't allow the ALOC to monitor the brigade A&L net. The engineer battalion is the only battalion in the brigade not on the brigade A&L net. As a result, the engineer ALOC is out of the loop for essential CSS information and coordination necessary for brigade mission success. The nature of engineer operations requires detailed coordination and cross talk among the engineer ALOC and the brigade and task force ALOCs. For example, Class IV resupply operations and task organization changes require detailed coordination to effectively distribute assets and materials. Allocation of a fourth radio would allow the ALOC to monitor the brigade A&L net.

Recommendation: *Allocate the engineer battalion ALOC two additional radios and change the architecture to allow the ALOC to monitor the proper nets.*

Typically, Force XXI maneuver battalion field trains command posts (FTCP) and headquarters company combat trains command posts (CTCP) are colocated and have a seven-net capability. They monitor task force command, A&L, brigade A&L, FSB command, and three other nets. The engineer battalion ALOC is required to perform both roles and, as a minimum, requires four-net capability to monitor engineer battalion command, engineer A&L, brigade A&L, and the FSB command nets.

Problem: *The appliqué architecture does not allow the Maneuver Support Company to monitor the A&L net for voice traffic.*

The Maneuver Support Company lacks even one platform with voice communications with the ALOC; the architecture

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dictates total dependence on digital message communication with that company. Digital message traffic, even if dependable, is not sufficient for battle or CSS tracking and does not support the ALOC's role as alternate battalion TOC.

Recommendation: *Change the architecture to allow voice communications between the Maneuver Support Company and the ALOC.*

Problem: *The battalion and company TOCs are not allocated a radio to monitor the battalion A&L net.*

According to current architecture, the engineer battalion and company TOCs do not have engineer A&L net capability, and the current MTOE does not allocate a radio to monitor the A&L net. As a result, the ALOC's only link to the engineer battalion and companies is through one of six platforms: the command sergeant major, the four company first sergeants, or the headquarters company commander. In addition, each vehicle is a light-skinned, low-survivability vehicle that is easily killed, further degrading the ALOC's ability to communicate. This problem is intensified because the engineer company TOCs are the primary battle and CSS trackers for the company (not the company first sergeant as in a maneuver company). With no A&L capability in the TOCs, the engineer battalion and company TOCs cannot talk to the engineer ALOC unless one platform or the other deviates from the architecture by changing nets. This is not practical because changing nets for any length of time disrupts the flow of digital traffic and either pulls a major C2 node off command nets or clutters them with A&L traffic.

Recommendation: *Change the MTOE to allocate engineer battalion and company TOCs an additional radio and change the architecture to allow the TOCs to monitor the A&L net.*

Summary

The technological advancements tested by Force XXI are exciting and point to a new era of combat operations. As combat engineers, we must be able to communicate and coordinate CSS issues to support faster moving, more flexible maneuver forces. Solving the shortcomings that hinder engineer ALOC communications will help ensure our digitized Army of the future.

Captain Smith served in the 17th Engineer Battalion as platoon leader, A&O platoon leader, and a company XO. After the 17th reflagged to the 299th, CPT Smith served as battalion S4 throughout the Task Force XXI Advanced Warfighting Experiment. He is a graduate of the United States Military Academy and holds a master's degree in engineering management from the University of Missouri-Rolla.

Note From the Directorate of Combat Developments

By Mike Bonomolo

In essence, Captain Smith is correct. The initial version (1.0) of the Force XXI Battle Command Brigade and Below (FBCB2) software had the six-node limit, which included the initiator and the destination. This problem has been solved through the application of role-based functionality. Now, if a first sergeant sends a logistics message, the FBCB2 software configures the network so that the message will not "hop" through more than four nodes. The FBCB2 system no longer sends the message up and across to reach a destination, therefore eliminating lag and reducing handling errors.

The shortage of radios within the battalion ALOC is a much more difficult problem to solve. The ALOC is authorized a fax, an Enhanced Position Locating Reporting System User Unit (EPUU-V1), a mobile subscriber receiver/transmitter (MSRT), a lightweight computer unit (LCU), a Unit-Level Logistics System (ULLS)-S4, and a VRC-89D radio. The maneuver battalion configuration can monitor up to seven FM nets between the FTCP and the battalion task force CTCP. Because the engineer battalion is not authorized a battalion task force CTCP, it is required to perform both roles from the engineer battalion FTCP. At the next command, control, communications, and computers (C4) configuration board in early FY99, we will recommend adding a single-channel, ground-to-air radio system (SINCGARS) with dual-net capability. Although operational requirements show that divisions need approximately 700 SINCGARS, there are only enough available to fill 535 of these requirements.

A joint tactical radio is being developed that passes voice and digital traffic simultaneously. This radio, which is scheduled for distribution in the FY03 time frame, should align the requirement of radio nets monitored with the capability on hand. In the interim, voice-based logistics messages must move to a digital format. The LCU can move digital message traffic within the battalion. The success of this option weighs heavily upon fielding the updated Maneuver Control System.

PERSCOM NOTES

Limited Call to Active Duty for Captains

By Major David Hartley

The Army is conducting a call to active duty for captains in basic branches. **The original recall message was amended on 8 July 1998 to delete the requirement for officers to be branch qualified.** Applicants for active duty are restricted to captains who are in the United States Army Reserve (USAR), Army National Guard (ARNG), or former active duty officers. Neither USAR Active Guard and Reserve (AGR) nor ARNG AGR officers are eligible. Applications from lieutenants or field grade officers will not be accepted.

This call to active duty expires 30 September 1998.

To be eligible, applicants must meet the following parameters:

- Have a captain's date of rank of 941002 or later.
- Have not been passed over for promotion while on active duty.
- Be advised that those who received Voluntary Separation Incentive Pay (VSIP) or Special Separation Benefit (SSB) pay when they left active duty may have to repay that amount.
- Have a bachelor's degree or higher.
- Be medically qualified.
- Meet the height and weight standards outlined in AR 600-9.
- Be able to attain 20 years of active federal commissioned service (AFCS) by age 55.
- Be able to complete 10 years of AFCS before completing 20 years of active federal service.

PERSCOM has approval authority for this specific call to active duty. The authority for accession is 10 USC 12301 (D) and AR 135-210. Information on application procedures and forms is available from Ms. Smith at commercial (800) 325-4898 or Defense System Network 892-3398.

Major Hartley serves as officer coordinator for the Engineer Personnel Proponency Office at the U.S. Army Engineer School.

NCO Advancement

By Sergeant Major Jay Florance

A question we hear from soldiers is, "What can I do to get ahead?" For NCOs, there are several opportunities to excel and get in the best position for advancement.

A sergeant (P) or staff sergeant needs at least two years of squad leader time. This is more of a challenge in some military occupational specialities than others, but avoiding this duty puts you behind your peers. Once you gain this experience, look for a job in a table of distribution and allowances (TDA) environment that broadens your NCO skills. Jobs such as drill sergeant, recruiter, and instructor will help develop a career path. Most NCOs will be considered for one of these duties, so be proactive in letting your branch know your desires so we can schedule the best time possible. To be eligible, you must have a general technical (GT) score of 100 or higher and have no derogatory information in your personnel file. To a limited extent, duty at the Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana; the National Training Center (NTC) at Fort Irwin, California; or with a reserve unit are possibilities. All of these jobs, when performed successfully, will help you achieve your career goals.

The most important job as a sergeant first class is time as a platoon sergeant. Following this experience, several jobs can help achieve the next plateau. Any job accomplished successfully at the grade level beyond your present grade indicates to the board that you are capable of handling responsibilities required of that grade. Sergeants first class who have the rare opportunity to serve as first sergeants, and who serve with distinction, are in the top percentile for advancement. Being an operations sergeant helps broaden your scope of military functions. There are TDA opportunities, especially if you have not yet served in one of these positions. Most jobs for sergeants first class are with reserve units, at the JRTC or the NTC, or as an instructor.

Remember that your peers are seeking these same skills. Since each NCO who gets a second TDA assignment keeps someone else from getting his first one, few will get a second TDA job. If your GT score is below 100, get with your education center and raise your score above 100. Most TDA jobs are tough, but success in them shows promotion boards you can adapt to that environment.

Your record has a lot to do with the duty you get and when you get it. Strong and consistent NCOERs determine the jobs you qualify for, so remember that every job is important! Concentrate on getting the troop time first and a TDA job second. If you have already worked one TDA job as a staff sergeant, get back into a modified table of organization and equipment (MTOE) unit before performing another TDA assignment. Too much TDA time can be a distracter! Some NCOs get into a TDA environment and never go back to troop-leading positions. This is a disadvantage since it appears they are "hiding" from the field unit environment. The Engineer Branch is available to provide career counseling.

Sergeant Major Florance serves as the Engineer Branch sergeant major at PERSCOM. His e-mail address is florancj@hoffman.army.mil.

Engineer Support to Engagement Area Development

By Major Kenneth J. Crawford

Most engineers are challenged when they prepare for combined arms defensive operations—it's never the same twice in a row. What we do to effectively integrate engineer expertise into engagement area planning depends on the military decision-making process (MDMP). We must thoroughly understand the impact engineers can have in tactical operations. This article describes how staff engineers can best support the planning phase of engagement area development during the MDMP.

Development Steps

Successful integration of engineer capabilities into the MDMP requires that we read, understand, and apply our knowledge of the supported unit's doctrine and tactical standing operating procedures (TACSOPs). Engineers who support division or brigade defensive operations that assign or direct engagement areas must understand how to effectively integrate their capabilities into engagement area development.

Doctrine provides a sound planning reference that must be applied to the current situation and surrounding terrain. Figure 1 shows a variation of the seven steps of engagement area development found in FM 71-1, *Tank and Mechanized Company Team*, and FM 7-20, *The Infantry Battalion*. The most significant difference is the switching of steps 4 and 5—positioning forces (direct-fire assets) before planning and integrating obstacles. This switch is logical because the maneuver commander is the "client" we support. In addition to pointing to a map and stating where he wants to kill the enemy (step 3), the maneuver commander must conduct mission analysis and understand the enemy's intent (steps 1 and 2) and know what he can see to kill throughout the depth of the battlefield.

1. Identify all likely enemy avenues of approach.

2. Determine likely enemy schemes of maneuver.

3. Determine where to kill the enemy.

4. Position direct fire weapon systems.

5. Plan and integrate obstacles with direct fires.

6. Plan and integrate indirect fires with direct fire and obstacles.

7. Conduct rehearsals.

Figure 1. Engagement area development steps.

Developing a defensive course of action (COA) takes each battlefield operating system into account and synthesizes a combined arms team designed to achieve a given mission against an attacking enemy. The focus of the defense is to destroy or defeat the enemy at predetermined sites where terrain favors the defending friendly forces—the engagement areas. Determining what will be critical events, or decision points (DPs), during defensive operations requires detailed planning, analysis, war gaming, and synchronization. DPs trigger multiple actions during combat operations and must be synchronized by thorough staff planning and coordination. When executing defensive operations, commanders fight from a position that allows them to visualize the battlespace (the three-dimensional fight). Engineers are the best-suited personnel in the combined arms staff to facilitate terrain visualization and positioning of forces during the MDMP.

To support the maneuver commander's intent and the combined arms staff, engineers must apply our capabilities and knowledge to each step of engagement area development. Just as the engineer estimate provides a format to align planning efforts with the MDMP, the following process provides an effective tool for defensive planning.

1. Identify all likely enemy avenues of approach

Staff engineers work closely with the S2 to analyze the terrain as soon as the mission is received. This is the first step in the engineer battlefield assessment. The OCOKA (observation and fire, cover and concealment, obstacles, key terrain, and avenues of approach) analysis must include the impacts of weather and the advantages and disadvantages that terrain offers. Engineers identify maneuver elements (friendly and enemy) favored by the combination of terrain and weather and explain why. Terrain visualization enables engineers to identify potential sites that offer an advantage over the range of the enemy's maneuver and weapon systems. Use of TerraBase II software and the Division Terrain Teams can help identify areas where terrain facilitates enemy approaches into our engagement areas behind intervisibility lines or through restricted terrain. Products engineers can easily produce to help in this process are lines of sight, obliques, weapon range fans (to identify dead space), and perspective images. As these products are developed, engineers should analyze them to determine the time and distance that enemy forces maneuver through and to estimate how long we can engage him with fires. These products can be used throughout the MDMP as tools for COA development (positioning of forces), war gaming, and rehearsals.

Engineers should consider the following factors when analyzing the avenues of approach through assigned sectors:

- Compartmentalization of the terrain and possible engagement windows for direct-fire and wire-guided missile systems (time of flight vs. tracking vs. enemy's ability to accurately return fire).
- Locations where the combination of terrain and man-made obstacles can achieve the desired effect.
- Availability and use of the Division Terrain Team. Early identification and prioritization of products created using TerraBase II promotes efficient use of resources by eliminating "nice to have" products. Since the situation and the commander dictate what is important for each mission, an SOP for product requirements is not needed but can be used.

2. Determine likely enemy schemes of maneuver

Engineers focus directly on the enemy's mobility/survivability capabilities and limitations during the second step of the engineer battlefield assessment. Working with the S2, they develop an estimate of enemy mobility/survivability assets and the order of battle, using TRADOC Pamphlet 350-16, *Heavy OPFOR Tactical Handbook;* FM 100-60, *AR and Mechanized-Based OPFOR Organization Guide;* and FM 100-63, *Infantry-Based OPFOR Organization Guide.* This step is critical because obstacle groups in engagement areas are designed to defeat the enemy's ability to sequentially breach or bypass obstacles in depth. Determining how the enemy will employ breach assets along an avenue of approach is a "best guess" based on staff engineers' knowledge and experience. The success of massed direct and indirect fires hinges on our ability to accurately site and emplace obstacles and target specific enemy mobility assets. Additionally, this step helps us to identify, recommend, and prioritize high-value targets.

3. Determine where to kill the enemy

By accurately estimating the force size, formations, speed, and the most likely and most dangerous COA along specific avenues of approach, engineers can predict where the enemy will transition his formations. Although distances for these transitions vary depending on the tactical situation, the following sequence and distances are doctrinally correct for an enemy attack:

- Mechanized infantry brigades transition to individual mechanized infantry battalion columns at 12-15 kilometers.
- Mechanized infantry battalions transition to company columns at 4-6 kilometers.
- Companies transition to platoon columns at 2-3 kilometers.
- Platoons transition to attack formations at 600-1,000 meters from the main defense.

If the situation permits, we can use ground or air observers, ADAM/RAAM, or attack aviation (provided we have air parity and a synchronized suppression of enemy air defenses [SEAD] plan) to disrupt the enemy's command, control, and maneuver as he transitions from battalions/companies in column to battalions/companies on line. Companies begin to transition to platoons in column where we plan to engage with tank- and wire-guided missile systems. If the combined arms staff can identify where the terrain masks enemy maneuver, it can position systems (covert operations lazing teams [COLT], scouts, fire support teams, observer teams, etc.) to engage enemy vehicles on the high-value target list. Otherwise, these vehicles may be in dead space to direct-fire systems that occupy DPs.

4. Position direct-fire weapon systems

Terrain surrounding potential engagement areas is the most significant factor in positioning direct-fire weapon systems. Although the range capabilities of our weapon systems are

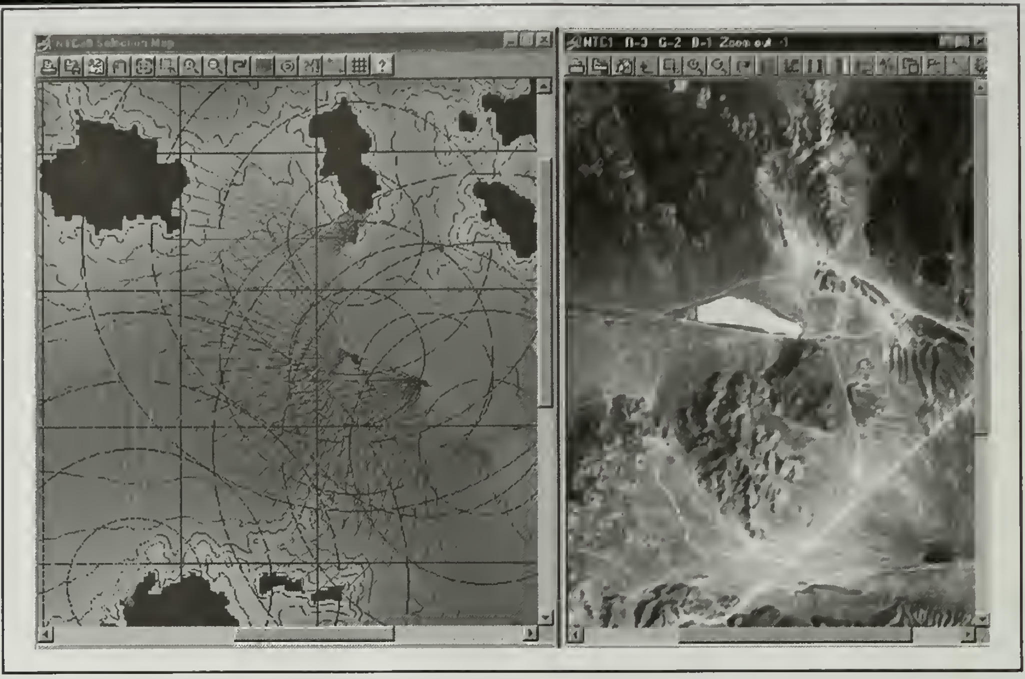


Figure 2. Direct-fire systems can be tentatively sited using a combination of terrain analysis and imagery. Above left depicts the center of mass for company team battle positions overlooking Drinkwater Lake at the NTC. To the right is a satellite image of the area.

considerable, the enemy has the advantage with wire-guided systems (the AT-5/8 = 4 kilometers and the AT-10/11 = 5 kilometers). Engineers must analyze the terrain to determine how to minimize the range of enemy systems. Use a reverse slope defense, intervisibility lines, defile, or integrate obstacles with restricted terrain to prevent him from maneuvering large formations.

The decision aids (tools) created in steps 1-3 are used to identify the best locations for the engagement area. For example, a weapon range fan shows that we can observe and engage a vehicle in an avenue of approach for 2.5 kilometers. The next step is to calculate how long it will take the enemy to move that distance at a given rate of march (2.5 kilometers/20 kilometers per hour = .13 hours or 7 minutes 30 seconds). At this range, the tracking time for our wire-guided missile systems (12 seconds at 211 meters per second) and 120-millimeter main gun (2 seconds at 1,517 meters per second) is an important factor. The maneuver S3 knows the distance where the probability of hit (P_h) and probability of kill (P_k) are highest. For planning purposes, determine these probabilities for each type of maneuver unit (mechanized and armor) based on the unit's Table XII gunnery and apply them as a constant.

Vegetation is another consideration. Neither the Digital Topographic Support System (DTSS) nor the TerraBase II program accurately shows how vegetation affects observation at any given position. We must analyze maps and conduct reconnaissance to confirm data the DTSS or TerraBase II provides.

Engineers may create additional products that support COA development and use them when completing the analysis and decision steps of the MDMP. The only limitations on product development are time, initiative, and experience. The needs of the supported element will dictate which products are most useful.

After the commander selects a COA, the staff provides the terrain products to subordinate units for their use during reconnaissance and when occupying positions or sectors. The terrain selected for the fight drives the frontages of each subordinate element. For example, when fighting in an open desert, the frontage of a defending platoon can be extended significantly further than when it is defending in rolling and forested terrain. Prepare for the possibility that terrain and vegetation may degrade the range of enemy and friendly weapon systems to meters rather than kilometers.

After tentatively identifying positions for weapon systems throughout the sector (Figure 2), the staff engineer can develop a survivability execution matrix for blade assets. After the COA decision brief, the commander's survivability guidance may include:

- General intent for engineer effort.
- Priority of support by unit, engagement area, and/or phase.
- Focus of digging assets, including the survivability level and priority for each system.
- Level of force protection for key command, control, and communications nodes.

If the COA calls for alternate, supplementary, or successive battle positions, use the data developed in the third step of the engineer battlefield assessment and identify what support engineers can provide. If the COA requires additional blade assets, identify the duration, benefits gained, and the potential impact or alternatives if the assets are not available. The TACSOPs must state that occupying maneuver units, not engineers, are responsible for positioning systems. Once maneuver elements identify these positions, they must mark and prioritize the positions to maximize the efficiency of blade assets (Figure 3). However, as the terrain experts, engineers must coordinate with the supported unit before the blades arrive and recommend ways to improve blade effectiveness based on site conditions (rocky, water table, egress routes, etc).

5. Plan and integrate obstacles with direct fires

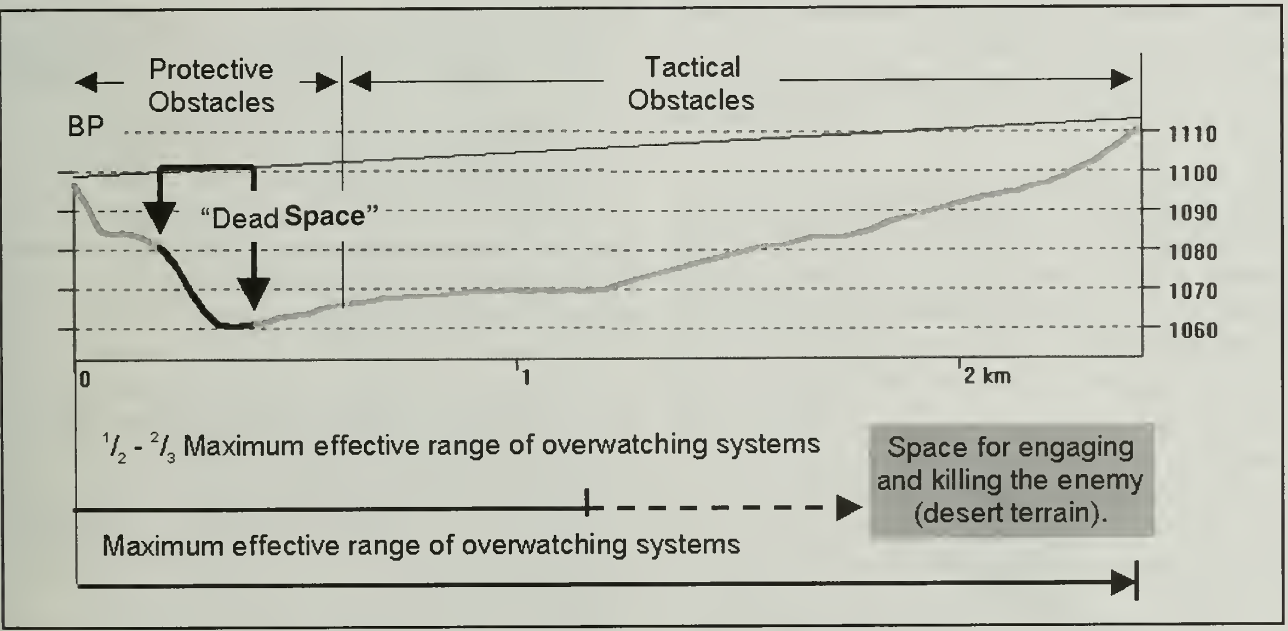
FM 90-7, *Combined Arms Obstacle Integration,* describes how engineers can be most efficient and effective during obstacle emplacement. This step comes after the direct-fire weapon systems are positioned. To effectively site, mark, emplace, and turn obstacles in sector, engineers must know what can or cannot be seen from the battle positions (Figure 4). When analyzing the combined effects of obstacles and direct fires, we must know the P_h, based on the percentage of vehicles entering the observed obstacle group and detonating a mine.

The enemy decides whether to breach or bypass an obstacle group. If he elects to breach, use the P_h for the obstacle effect (see Figure 5, page 44), combined with the P_h/P_k of our direct-fire weapon systems to determine the number of vehicles the enemy is likely to lose. For example, the direct-fire engagement trigger will be the lead motorized rifle battalion (MRB) encountering a fix effect obstacle group. The P_h for an MRB in battle formation is 50 percent (worst case). This equates to four vehicles through the depth of the obstacle group (nine tanks lead in an MRB attack formation). The enemy must react to the obstacle encounter, which triggers the overwatching elements' direct-fire engagement. A tank company team firing against a lead enemy battalion (approximately 42 combat vehicles) at a range of 2.5 kilometers may have a P_k of 90 percent. This would yield 29 enemy vehicles remaining at the end of the first volley (42 enemy vehicles -[14 friendly vehicles engaging X 90 percent P_k = 12.6] = 29.4 or 29 enemy vehicles remaining).

Figure 3. Maneuver company team commanders must site and mark positions before survivability assets arrive. Blade teams must understand the standard for the types of positions they are to prepare.

Few units have perfect fire control or distribution and kills for every round fired against a moving target. In this scenario, the combined effect of obstacles and direct fires is 25 enemy vehicles attempting to maintain command and control, maneuver, breach, and return fire. Specific fire-control plans destroy the enemy's primary breach assets. This may cause the enemy to fix friendly forces and wait for second echelon forces before continuing to move, attempting to bypass, withdrawing, or mechanically breaching through the obstacle group.

To clarify his intent and help develop the engagement area, the maneuver commander provides the following information to focus engineer countermobility efforts:



Protective Obstacles
Tactical Obstacles
BP
"Dead Space"
1110
1100
1090
1080
1070
1060
0
1
2 km
$^1/_2$ - $^2/_3$ Maximum effective range of overwatching systems
Space for engaging and killing the enemy (desert terrain).
Maximum effective range of overwatching systems

Figure 4. Example of a TerraBase II line-of-site view at Drinkwater Lake. It accurately depicts range, dead space, and elevation data from a given point on the ground.

Standard planning factors identify the resources (Class V mines) required to emplace obstacles along an avenue of approach as follows:

Obstacle Effect	Resource Factor (RF)	Probability of Hit (P_h) (percent)	Linear Density
Disrupt	0.5 X AA	40 - 50	0.4 - 0.5
Fix	1.0 X AA	50 - 60	0.5 - 0.6
Turn	1.2 X AA	75 - 85	0.9 - 1.1
Block	2.4 X AA	>85	>1.1

AA = Avenue of approach.

Linear density (LD): number of mines ÷ front length(m) = mines per meter of front.

Area density (AD): number of mines ÷ front X depth = mines per m^2.

To convert AD to LD: AD X depth(m) = LD.

Figure 5. Minefield probability planning based on effect

- Priority of obstacle effort by engagement area or phase.
- Intent for obstacle effects—disrupt, fix, turn, or block. (These are the results the maneuver commander wants to achieve through combined use of direct fires, obstacles, and indirect fires along specific avenues of approach.)
- Mobility requirements and obstacle restrictions (counterattack axis, main supply routes, withdrawal routes, reserve obstacles, etc.).
- Intent of employing scatterable mines or situational obstacles (by system—where, when, duration, and authority).
- Maneuver forces' support to obstacle effort (guard force requirements for reserve obstacles, marking, mine dump and Classes IV and V support, etc.).

Note: Using engineers to mark obstacles, in addition to emplacing them, reduces the total amount of obstacle effort in sector.

- Obstacle protection (counterreconnaissance, reseed plan, deception, enemy breach asset destruction).
- Obstacle command and control (execution authority, marking, lane closure, reporting, tracking, restrictions, and control measures—zones, belts, and groups).
- Obstacle deception.

Situational obstacles require a significant amount of staff synchronization. Step 2 identifies how the enemy is likely to attack and employ breaching assets according to the order of battle. The trigger for situational obstacles is one of three things: enemy action, friendly action, or a combination of both. By employing a scatterable mine system triggered by enemy action (for example, a company-sized or larger force approaching or passing through a DP), the distance from the targeted area of interest (TAI) to the DP can be calculated using the following equation:

$\underline{\mathbf{M^3 + E + A < T > C}}$, where:

$\mathbf{M^3}$ = the cumulation of the following applicable times. The cumulation must be less than the time it takes the enemy to reach the TAI.

- Movement of communications (time required for the observer to call the controlling HQ, plus the time for the HQ to receive approval from the authorizing commander, plus the time for the HQ to direct the emplacing element/unit to execute).

- *Move to TAI* (the time required to move/fire to/into the TAI [ground/air systems or time of flight for indirect munitions]).

- *Move from TAI* (the time required for the element/unit to move from the end point to a reload or secure hide position).

E = time required to dispense or fire the mission.

A = time required to arm/activate the munitions.

T = time required for the targeted enemy element to move from the first observed location in a named area of interest (NAI) to the TAI (or obstacle location). Contact there is initiated by either a mine strike or direct fires from an overwatching element.

C = time required to position a friendly maneuver element in an overwatching battle position. Friendly forces must establish a defensive posture in a battle position (or other advantageous position) before the enemy has the opportunity to engage. (Plan a minimum of a 4-kilometer range for enemy antitank weapon standoff and understand the risk when applying lesser distances.)

Maneuver commanders at company team, battalion, and brigade levels must ensure that obstacles, direct-fire weapon systems, and indirect fires are integrated. Ground reconnaissance cannot be replaced with "eyeballing" a map or using decision aids developed for the COAs. Ground reconnaissance helps site obstacles and must occur as early as possible. To expedite obstacle emplacement after the COA is approved, staff engineers provide subordinate engineer units with information to help them begin parallel planning and direct coordination between engineers and supported maneuver units. When the MDMP is complete, execution matrices, time lines, Classes IV and V resourcing and allocation, and a survivability plan are developed and included in both the Engineer Annex and the subordinate engineer operations order.

6. Plan and integrate indirect fires with direct fire and obstacles

As staff engineers identify obstacle groups, fire support coordinators develop a fire plan to support the intended effects of engagement areas. They target fires on the enemy side of obstacles where the enemy is most likely to be (dead space), the point at which assets begin to canalize through a breach point, or at targets determined by the maneuver commanders and subordinate fire support teams. The point where obstacle groups tie, or anchor, into existing obstacles is critical. The anchor point is where the combined effects of the obstacles and fires force the enemy to commit to a breach or seek a bypass.

This is not the time to consider using ADAM/RAAM, because integrating ADAM/RAAM must be done early to be effective. The maximum planning range of scatterable munitions is 17.5 kilometers for M109 fires and 17.7 kilometers for M198 fires. If the point along an avenue of approach where the second echelon mechanized infantry brigade transitions from battalions in column to battalions on line can be targeted, or if the advanced guard main body can be separated from the second echelon battalions, we can identify the associated NAIs, DPs, and TAIs to support this mission. The key concern is whether it will take more than 15 minutes for a battery to fire the mission. When developing the COA, identify how many artillery batteries are available to support the mission and determine whether to use low- or high-angle fires. Since the maximum rate of fire is four rounds per minute per tube, the angle of fires directly impacts the length of time and number of rounds it will take to fire the mission. Generally, high-angle fire requires four times more rounds than low-angle fire for RAAM. Therefore, more time or tubes may be required to complete the mission.

The staff must weigh the advantages and disadvantages of the time it may take the fire support elements to complete the mission (for example, copperhead, interdiction, SEAD, or suppression) and make recommendations to the maneuver commander. He must decide whether to use artillery tubes to fire ADAM/RAAM missions based on the size and type of enemy element (target), the P_h for the avenue of approach (location), and the overwatching elements' ability to observe/engage the enemy as he negotiates the obstacle (effect).

7. Conduct rehearsals

Units conduct combined arms rehearsals to ensure that all elements are properly synchronized. Review CALL Newsletter No. 98-5, *Rehearsals,* and incorporate its concepts into TACSOPs. Specific engineer-related topics addressed in combined arms defense rehearsals follow:

- Priorities of engineer effort (obstacle group sequence of emplacement, who is marking, link up and execution of blade effort, Q36 radar and air defense artillery coverage).
- FASCAM triggers and execution ($M^3 + E + A < T > C$).
- Classes IV and V supply point and mine-dump operations. (These may be discussed during combat service support rehearsals but must be understood for the combined arms rehearsals.)
- Obstacle turnover, responsibility, and security.
- Lane closures.
- Counterattack mobility support.

At any given time during mission execution, engineers should be able to tell the maneuver commander where the engineer effort stands—the "glide path." Engineers must thoroughly understand and translate the impact that incomplete obstacle groups have on enemy maneuver so the commander can adjust his orders to achieve the same effects.

Summary

Engineer staff officers are key players in engagement area development. They produce quality and useful decision aids, integrate engineer capabilities into engagement area plans, understand the capabilities of supported units, and provide sound tactical recommendations to commanders based on a complete analysis of the mission, enemy, terrain, troops, and time available (METT-T). Engineers are especially important in terrain visualization. They know where to apply available tools to best support the commander's battlespace visualization during engagement area development.

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The Command Post SOP: A Blueprint for Success

By Captain Eric R. Price and Captain Jay A. Hedstrom

Six months have passed since you left the Advanced Course and were assigned as an assistant S3 in a divisional combat engineer battalion. In that time you have helped develop the battalion's training plan, which culminates with the battalion's first National Training Center rotation in two years. Today, as you update the battalion commander, many thoughts race through your mind. The battalion changes command in just two weeks; three key staff captains recently took command, leaving lieutenants to pick up the pieces; the battalion operations NCO just arrived last month; and enlisted personnel turbulence within the Headquarters Company is high. Your chest tightens as you realize for the first time that only two staff exercises remain before the rotation. The battalion commander reminds you that since the new S3 just arrived, you are the senior, most experienced man on the battalion's battle staff. Heading back to the office, you war-game ways to pull the staff together in the short time left to prepare.

In today's Army of rapidly changing missions and high personnel turbulence, integration and quick training of new personnel are prerequisites for success. Engineer battalions work hard to develop, refine, and execute simple battle drills at squad and crew levels. Limited training resources have resulted in focused platoon battle tasks and company mission essential task lists. However, many units spend little time organizing command post operations, or when they do, they fail to commit the results to paper. At best, this causes them to reinvent the wheel—rather than building and refining an existing product—every time a new commander, executive officer, or S3 assumes his duties. Worst case, units must re-establish procedures every time their command post deploys. In either case, the command post staff spends too much time managing internal operations rather than focusing on timely and effective command and control of combat operations. Units arriving at the National Training Center often are ill-prepared to execute the key staff battle task of operating the battalion tactical operations center (TOC). Battalions with a well-established Command Post Standing Operating Procedure (CPSOP) for their main, rear, tactical, and administrative command posts are better able to cope with the rapidly changing conditions of the battlefield and tend to conduct more successful combat operations.

This article describes a method the combat engineer battalion's battle staff can use to develop and implement a basic CPSOP. The method is applicable to all battalion command posts. It focuses on establishing the CPSOP around six basic TOC functions; identifying the key supporting tasks and related tactics, techniques, and procedures (TTPs) for each of these functions; and organizing and implementing those TTPs.

CPSOP Development

There are several ways to arrive at a workable CPSOP. Each member of the battle staff should first turn to doctrinal manuals, because it is important not only to understand his own duties and responsibilities but also those of other personnel. Many manuals include an overview of TOC operations, but few provide detailed guidance on establishing and implementing a workable SOP. Our CPSOP development begins with the six basic TOC functions identified in the Center for Army Lessons Learned (CALL) newsletter, *Tactical Operations Center* (May 1995).

- ☐ Receive information.
- ☐ Distribute information.
- ☐ Analyze information.
- ☐ Make recommendations.
- ☐ Integrate resources.
- ☐ Synchronize resources.

This CALL newsletter clearly explains how to assess current command post operations and develop a training plan for improvement. The six TOC functions are not listed in any Army field manual, but they fit the axiom "form follows function." In other words, decide up front what functions the TOC must perform to be successful. Then identify the methodology to best accomplish each function with available resources.

Despite calling them six "TOC" functions, they apply to the main, tactical, and rear command posts. Throughout this article, references to the TOC pertain to all combat engineer battalion command posts. To ensure that all essential tasks and supporting TTPs are addressed and fully integrated in the final product, all staff sections and other command post personnel must be involved in the development process. Begin by gathering personnel from each battalion command post to discuss these functions. Work together to determine essential tasks that support each function. Because each function depends on the others, some tasks don't fit well under any particular one. List those tasks separately, as they will be addressed further when CPSOP organization begins.

Tasks in the CALL Newsletter provide an excellent starting point for developing a list of tasks that support each TOC function. Identify additional tasks based on the unit's specific experience and mission. Detailed descriptions of the functions and supporting tasks identified in CALL's *Tactical Operations Center* follow:

Receive Information. Receive information through standardized reports and orders from subordinate, higher, and adjacent units. Supporting tasks include:

- ☐ Receive messages, reports, and orders.
- ☐ Monitor the tactical situation and track the battle.
- ☐ Monitor the location and activities of friendly units.
- ☐ Update TOC charts and heads-up displays.
- ☐ Update maps and overlays.
- ☐ Maintain a TOC journal.

Distribute Information. Control information distribution within the TOC; report information to subordinate, higher, and adjacent units.

- ☐ Submit reports.
- ☐ Control message traffic flow.
- ☐ Conduct retransmission operations.
- ☐ Conduct relay operations.
- ☐ Publish and distribute orders.
- ☐ Conduct shift change, command, and information briefings.

Analyze Information. Consolidate reports and conduct battle staff analysis as part of the Tactical Decision-Making Process (TDMP).

- ☐ Consolidate reports.
- ☐ Conduct predictive analysis using collected data.
- ☐ Develop a time line.
- ☐ Conduct the TDMP and orders drill.

Make Recommendations. Submit recommendations to the commander based on the analysis of information collected.

Integrate Resources. Coordinate integration of the unit's activities with those of subordinate, higher, and adjacent units.

- ☐ Conduct assistant brigade engineer and tactical operations.
- ☐ Produce annexes for the higher headquarters order.
- ☐ Receive and integrate engineer and combined arms attachments.

Synchronize Resources. Synchronize the unit's activities with those of subordinate, higher, and adjacent units.

- ☐ Conduct liaison operations.
- ☐ Coordinate with other units.

The following tasks relate to the overall operation of the command post and support all six basic TOC functions:

- ☐ Identify the task or purpose of each command post.
- ☐ Set up and dismantle the command post.
- ☐ Establish mission-dependent command post configurations.
- ☐ Establish guard, sleep, and shift manning plans.
- ☐ Monitor radios.
- ☐ Provide life support for TOC personnel.

After identifying essential supporting tasks, outline the TTPs used to execute each task based on doctrine and the unit's way of doing business. If the unit has no established method for executing an identified supporting task, brainstorm a method and commit it to paper. Since this is a working document, it's okay to try new things. However, the TTPs you develop should not conflict with other established SOPs for your unit or with those of your supported maneuver unit. Once TTPs for each supporting task have been identified, organize the tasks into a logical sequence to develop the layout of the CPSOP.

CPSOP Organization

The six basic TOC functions provide a means of identifying supporting tasks, but because the functions are interrelated, it is difficult to use them to organize supporting tasks in a final SOP. Instead, look at the tasks using the five "Ws"—*who, what, when, where, why*—and *how*. Sections of the CPSOP can then be designed around answering one or two of these questions. Organize each section by addressing the TTPs that support each task as it relates to all of the unit's command posts. Use subparagraphs or subsections as necessary to provide detailed information regarding TTPs that pertain only to one command post. The figure on page 48 shows a sample format.

Another method of organizing the CPSOP is to first list the main, tactical, and rear command posts and then discuss the manning, layout, and operation of each. However, this approach can lead to redundancy and a sense of compartmentalization. Addressing tasks in the CPSOP by the five "Ws" focuses on the fundamentals of command post operations before differences between each type are described. This method eases the transition of personnel from one command post to another within the unit, as often happens when units "surge" personnel to the main command post just before a battle.

CPSOP Implementation

The last stage in the process is to train and implement the CPSOP, thus turning written products into true TTPs for the entire battalion battle staff. While many approaches will achieve the desired results, CALL's *Tactical*

Operations Center newsletter suggests the following:

Conduct CPSOP Classes. Conduct classroom training for all command post personnel on tasks such as the TOC journal, battle tracking, reporting and TDMP procedures, displacement, and setup/teardown. Classes will familiarize personnel with procedures outlined in the new CPSOP.

Make the CPSOP Part of Garrison Operations. Take tasks from the CPSOP that mirror tasks currently performed in garrison and make them part of the daily routine. For example, train battle-tracking skills by maintaining a status board of the battalion's companies in the S3 shop using the command post heads-up displays. In addition, have radio-telephone operators answer phones, maintain a staff journal, and pass on messages using the same forms as those used in the command post. Train subordinate units to submit reports in garrison using the report formats in the tactical SOP.

Set Up the Command Post Every Month. Exercise load plans, storage plans, and multiple command post configurations. Coordinate for all the battalion command posts to set up and conduct communications exercises and TOC exercises simultaneously and regularly.

Integrate Command Post Operations Into Routine Unit Training. Don't set up command posts only during field training exercises or command post exercises. Use routine training events such as firing ranges and land navigation courses as training opportunities for the command post. Set up battalion command posts to support company training events so that both company and battalion command post personnel receive training.

Revise and Improve the CPSOP. Use the above training methods to validate the CPSOP. Reassess the TTPs and update them as necessary. The CPSOP must be a "living" document to meet the changing needs of an organization.

Conclusion

Observations at the National Training Center indicate a direct correlation between the ability of units to conduct synchronized and efficient command post operations and their level of success in executing combat missions. Unit tracking charts may not make the breach go in, but accurate information gives the commander and staff opportunities to take advantage of situations as they develop. A battalion battle staff can identify command post functions and essential tasks that support each function, commit those tasks to paper, and train them like a battle drill. Then they can use training opportunities like those provided at the National Training Center to train personnel in the art—rather than the mechanics—of command and control.

Captain Price, the engineer battalion logistical trainer, has been an observer/controller at the NTC since 1997.

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Sample CPSOP Format

Table of Contents

I. Command Post Overview ***(Why)*** - a brief description of the how and why of each command post.

- ☐ Mission of each command post within the unit (tactical, main, rear, combat trains, etc.).
- ☐ Task or purpose of each command post.
- ☐ Battlefield laydown and locations of command posts.

II. Duties and Responsibilities ***(Who, What)*** - a definition of the specific role each person plays in command post operations in terms of mission requirements.

- ☐ Manning and shift makeup and schedule.
- ☐ Life support for command post personnel.
- ☐ Roles and responsibilities of all command post personnel (battalion commander, executive officer, command sergeant major, primary staff and staff NCOs, support staff and staff NCOs, assistant brigade engineer, battle captains and battle NCOs, liaison officers, radio-telephone operators, drivers, etc.)

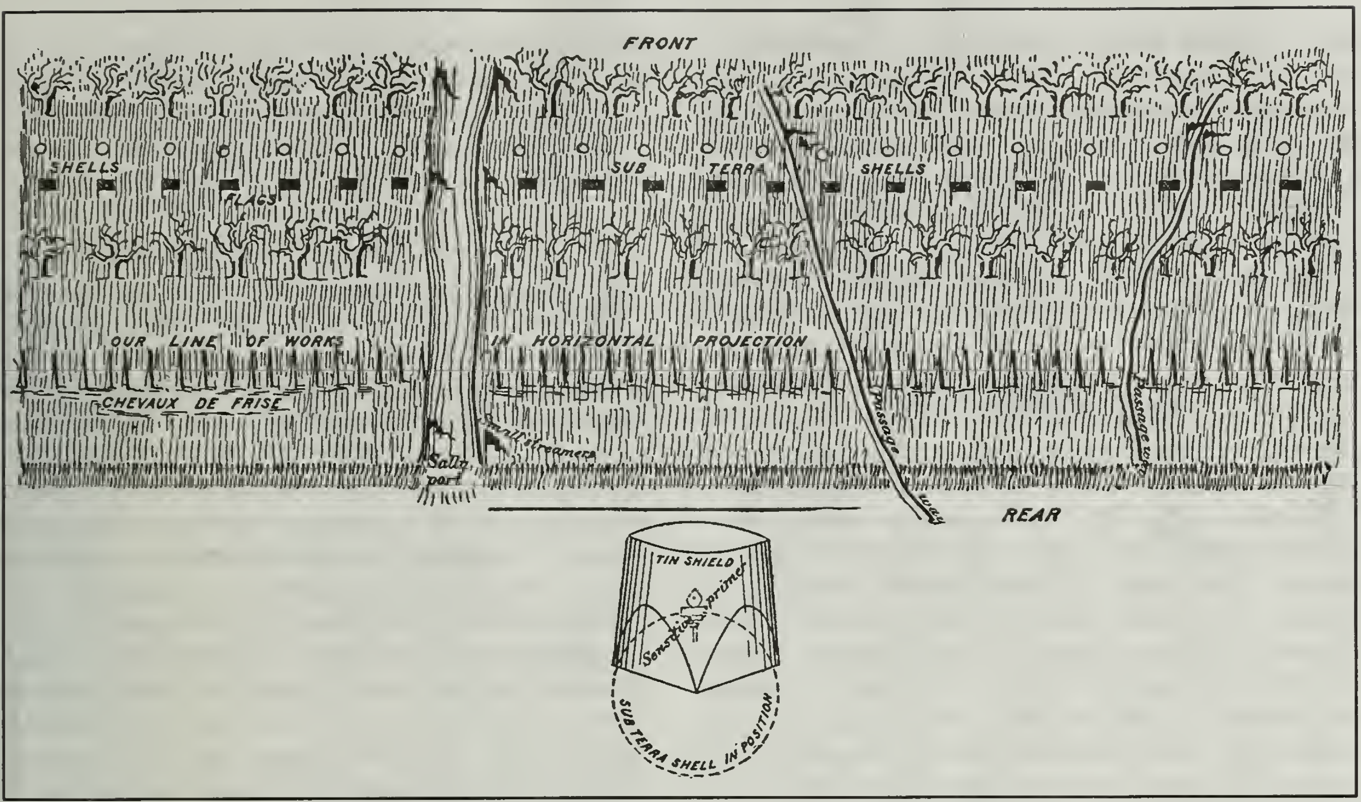
III. Command Post Layout ***(Where)*** - a detailed description of the command post's physical properties.

- ☐ Physical layout of command post vehicles, extensions, briefing tents, sleep tents, and antennas.
- ☐ Locations of maps, heads-up displays, equipment, equipment storage, supply storage, and personnel.
- ☐ Alternate command post configurations.
- ☐ Integration with supported unit command post.
- ☐ Security plan.
- ☐ Communications or other links with adjacent command posts.
- ☐ Required items such as maps, overlays, charts, orders books, manuals, and supplies.

IV. Command Post Operations ***(When, How)*** - a clear description of routine actions during the planning, preparation, and execution phases of combat operations. Lay out this section using the six basic TOC functions as an outline. It should address:

- ☐ Information management.
- ☐ TOC chart and heads-up displays.
- ☐ Battle-tracking procedures.
- ☐ Maintaining the command post journal.
- ☐ Briefing formats.
- ☐ Standard unit time lines.
- ☐ TDMP procedures.
- ☐ Reporting procedures.
- ☐ Shift-change procedures.
- ☐ Displacement procedures.
- ☐ Integration procedures.
- ☐ Retransmit and relay operations.

V. Standardized Charts/Heads-Up Displays ***(How)*** - examples of each tracking or information chart to be posted in the command post. These should be standardized across all command posts within the unit.



Earliest known sketch of a Civil War minefield (Official Record of the Rebellion, Vol 42, Pt. III, published 1893, GPO, Washington, D.C.)

The Origins of Military Mines: Part I

By Major William C. Schneck

Innovations in mine warfare have come from a variety of sources throughout history, and it is often engineers on the ground who gain the critical insights required for the next leap forward. Mine and countermine technologies and techniques have evolved over the past 3,000 years and continue to evolve in the typical measure/countermeasure/counter-countermeasure cycle seen for other weapons. Part I of this article traces that evolution from the first underground mines through the antipersonnel mines and boobytraps used during World War II.

Early Mining

Commercial underground mining first began in the Bronze Age when surface deposits of minerals and gems were exhausted, forcing miners to follow ore veins deeper into the earth by digging vertical shafts and horizontal drifts. The earliest identified underground mines, dating from 7000 B.C., were copper mines in Anatolia, now part of Turkey. Egyptians began to mine copper and turquoise in Sinai around 3400 B.C. The following Iron Age began among the Hittites, who mined iron ore between 1900 and 1400 B.C. They used this revolutionary material to make superior weapons that greatly facilitated the conquest of their neighbors.

Early in the Bronze Age, walled cities began to appear in the Middle East to protect against raiders and other attackers. Jericho, on the west bank of the Jordan River, just north of the Dead Sea, is the oldest known walled city (dating from approximately 8000 B.C.). The walls at Jericho were about 7 meters high and 4 meters thick and were surrounded by a moat 9 meters wide and 3 meters deep.[1] Later, protective walls developed into huge affairs. Under Nebuchadrezzar II (around 600 B.C.) the walls at Babylon increased to a thickness of about 26 meters.[2]

Early military mining techniques were developed in response to these walled cities and probably were devised by impressed civilian miners at the behest of conquerors. Before military mining, attackers' options were limited to blockading a city (starving them out), scaling the walls, breaching the walls with a battering ram (which began in Egypt about 2000 B.C.), or by stratagem (such as the Trojan Horse). Although the stone-throwing engine of war was first developed by the Phoenicians, the *catapult* was one of the first effective missile engines. It was developed for battering down town walls during the reign of Phillip II of Macedonia, the father of Alexander the Great.[3] In the third century B.C., the great military engineer Archimedes built a missile engine that could hurl a 173-pound stone about 200 meters. Engineers took their name from these "ingenious" devices.[4] Mechanical stone-throwing engines remained in action as late as the Siege of Rhodes in 1480[5] and Cortez' conquest of Mexico (around 1520). In fact, improvised grenade-throwing catapults were used in close combat situations during both world wars.

Early Military Mines

The Assyrian Army organized the first known "corps of engineers" during the time of Ashurnasirpal II (about 850 B.C.). These elite specialists operated siege and bridge trains and provided mobility support for chariots. They were the first soldiers equipped with advanced iron pioneer tools and are credited with the first known use of offensive mine warfare. This occurred about 880 B.C. when engineer soldiers drove tunnels (mines) under or through walls and fortifications[6] to gain access to fortified areas or to create a breach large enough for a full-scale attack. These engineers excavated a chamber under the wall and braced the ceiling with timber supports. The supports were then burned, causing the chamber and the structure above it to collapse. Attacking soldiers then assaulted through the breach.

Among the many successful mines throughout history are those used by Alexander the Great and his engineer Diades at the sieges of Halicarnassus (334 B.C.) and Gaza (332 B.C.)[7] and Julius Caesar and his engineer Mamurra during the siege of Marseilles in 49 B.C.[8] Although effective mining and other combat engineering skills were critical to the military successes of both of these great captains, the skills frequently are neglected by historians.

Early Obstacles

An early example of a reinforcing obstacle intended for use on a battlefield, as opposed to during a siege, occurred around 330 B.C. during the time of Alexander the Great. The Greeks were aware of a new invention called *caltrops,* which could be scattered in front of their battle lines to disrupt the terrifying attacks of the massive Persian war elephants.[9] Caltrops are devices with four metal points arranged so that when three are on the ground, the fourth projects upward as a hazard to animal hooves or tires. Caltrops were used as recently as the Korean Conflict, when the U.S. Air Force dropped them on Chinese convoys to puncture tires. The U.S. also dropped them on the Ho Chi Minh trail during the Vietnam War.

During the siege of Alesia in 52 B.C., Julius Caesar's engineers directed the emplacement of a complex obstacle 100 meters deep. It was a combination of towers, palisades, ditches, abatis, and caltrops to slow the attacking Gauls, so that Roman missile engines could more effectively engage them. These obstacles gave Caesar time to successfully deploy reserve forces to threatened areas along his 13-mile perimeter.[10] Another early obstacle is the *abatis,* emplaced by English longbow men to protect against mounted French knights at the Battles of Crecy (1346) and Agincourt (1415).[11]

Black Powder

Although the origin of black powder is uncertain, it probably was developed by Chinese alchemists seeking an "elixir of immortality" during the T'ang Dynasty around 850 A.D. It was used against the invading Mongols of Ghenghis Khan in 1209.[12] Black powder apparently remained an oddity, for although it terrified those unfamiliar with it, the Chinese did not successfully integrate it into an effective weapon. It apparently impressed the Mongols, who carried black powder with them during their reign of conquest and introduced it to Europeans at the disastrous Battles of Liegnitz and Sajo River in April 1241.[13] The advent of black powder in Europe marked the beginning of modern artillery, when it was fired from mechanical missile engines used by military engineers of Medieval Europe. In fact, the term *gunner* may be a variant of "gynour," a form of engineer.[14] *Serpentine* powder, the earliest form of black powder, was a dust that burned slowly and gave low bore pressure. A method of "corning" powder into larger grains to increase performance was developed about 1450.[15]

Explosive Mines

The ability to manufacture and detonate black powder occurred in Europe in the 14th century and resulted in the next major improvements in military mining.

Tunnel Mines

The surprise and effectiveness of tunnel mines was significantly increased by exploding large charges of black powder at the end of galleries driven under fortifications. The first recorded use of such a mine in Europe was in 1403, during a war between Pisa and Florence, when the Florentines exploded a charge in a forgotten passage in the walls surrounding Pisa.[16] One of the individuals involved with these early explosive mines was a military engineer named Leonardo Da Vinci, who was working for Ludovico, the Duke of Sforza, around 1500.[17] However, for a long time black powder was a scarce and expensive commodity,[18] so the less spectacular method of burning out the timber supports beneath the walls continued for some time.[19] The slow evolution of the cannon eventually forced the high castle walls of the Middle Ages to be replaced by low-walled bastioned fortresses, finally making this method of mining completely obsolete.

In his work on siege warfare (published in 1740), Sebastien Le Prestre de Vauban (French Marshal, 1630-1707) codified principles of military mining that remained valid well into the 19th century.[20] Vauban, in what could be considered the first scientifically based demolitions manual, described a method of charge calculation and placement based on characteristics of the target fortress and the desired effect. He defined these mines by the depth and size of the charge:

- For depths less than 3 meters, it was called a *fougasse* (or *contact mine).*
- For depths greater than 3 meters, it was called a *mine.*
- When used as a "countermine" against an enemy mine, it was called a *camouflet.*
- When intended to destroy an entire fortification (using 2,500 kilograms of powder or more), it was called *pressure balls (globes de compression).*

According to Vauban's tables, explosive charges for mining could range up to 12,200 kilograms. The purpose of mines was not only to cause destruction but also—with the rocks and soil ejected—to form an earthen ramp that assault troops could use to gain immediate access to the breach. Because the demolition often came as a surprise to defending forces, it frequently caused panic and confusion among them.

Tunnel mines were very time consuming to employ. Typically about 18 miners and 36 unskilled workmen were employed in three 8-hour shifts to construct an assault mine. Military mining during a siege could last 30 days or more, and specialists were required for the job. During the Middle Ages, coal miners were hired. Formal mining units were not formed until standing armies were raised by the absolute monarchs of the 17th century—1673 in France, 1683 in Austria, 1742 in Prussia, and 1772 in Britain (the Company of Soldier Artificers). Their work demanded courage and special caution—lack of oxygen and possible flooding were hazards.

Against the bastioned fortresses of Vauban's time, mining normally began as soon as sappers (military specialists in attack and defense of fortifications) completed the last parallel in front of the glacis of a fortress or fortified town. Then besieging miners dug galleries about 1.25 meters high and 1 meter wide and lined them with wood. Once they reached the site selected for the explosion, they dug the blast hole perpendicular to the previous direction of the gallery. Then they filled the mine chamber with the amount of black powder determined by the siege engineer.

To ignite the mine, they fed an ignition "sausage" out of the mine chamber. This sausage was a tube made of linen and filled with granulated black powder that led back to the point of ignition (minenherd). The ignition sausage, a predecessor of the modern time fuze, was normally laid in a 6-centimeter-wide wooden duct and covered with a board to protect it from moisture or other damage. The gallery was finally tamped with sod or earth, over a length of 6 to 10 meters. At the appointed time, the miner ignited the powder in the ignition sausage with an ignition sponge and then retreated quickly before the sponge burned to the powder.

Immediately after the explosion, the besiegers could assault the fortress or extend their sap trenches into the crater and reinforce them with gabions. If necessary, additional mines were used to destroy the palisades of the covered passage and the supporting walls of the counterscarp or scarp, thus facilitating entry into the fortress.

While working in tunnels, miners looked for the defenders' listening tunnels and countermines. Attackers tried to deceive the defenders' listening posts by constructing phony "noise" galleries, where they intentionally made a lot of noise. [21]

Military engineers incorporated the latest technologies from civilian mining as they became available, including more efficient explosives: nitrocellulose in 1845 (Christian Schoenbein, Germany), dynamite in 1866 (Alfred Nobel, Sweden), picric acid in 1871, and TNT in 1902 (C. Hausermann, Germany).[22] Other improvements included electric (galvanic) ignition (1850s)[23] and forced-air ventilation systems. During World War I, both sides employed new mechanical tunnel-boring machines developed for commercial coal mining, as well as traditional techniques.[24]

Tunnel mining has continued sporadically into the modern era and was used by Napoleon at Acre (1799), the Crimean War (Sevastopol),[25] General Grant's men in the American Civil War (Vicksburg[26] and Petersburg[27]), the Russo-Japanese War (Port Arthur[28]), World War I (Western Front[29] and the Isonzo Front[30]), World War II (Russian Front[31]), and the French-Indochina War (Dien Bien Phu[32]). Most recently, the Peruvians used tunnel mines to liberate hostages held in the Japanese ambassador's residence in Lima. The North Koreans may use them in the future—some of their tunnels have been discovered under the demilitarized zone (DMZ) and more are suspected.

Fougasse[33]

Frederick the Great, King of Prussia, stated that "Fougasses formed into a T-like mine, in order to blow up the same place three times, can be added to the entrenchments. Their use is admirable; nothing fortifies a position so strongly nor does more to ward off attackers."[34] These fougasses were simple black powder devices first developed for defending permanent fortifications. They were intended to detonate in the face of an enemy assault. A black powder charge was placed in a chamber excavated in the face of a fortification (firing horizontally) or in front of it (firing vertically). The chamber was then packed with a quantity of fragments, normally rocks or scrap iron and called a *stone fougasse,* or filled with explosive artillery shells and called a *shell fougasse.* If properly emplaced, a horizontally fired fougasse functioned as a crude claymore mine, while the shell fougasse could function like a bounding antipersonnel (AP) mine or a simple fragmenting mine. Fougasses were command-detonated by manually igniting a powder train from a protected position at the appropriate time. Fougasses had several defects: they were vulnerable to the elements—even moderate dampness rendered them inoperative—and were difficult to detonate at the optimum time. However, in the right circumstances, *fougasses* caused heavy casualties, as occurred during the sieges of Ciudad Rodrigo, Badajoz, and Santander in the Duke of Wellington's Peninsular Campaign of the Napoleonic Wars.

Fougasses were employed by one of George Washington's engineers, Francois de Fleury (of de Fleury Medal fame), in October 1777 against the Hessians at Fort Mercer, New Jersey, on the east bank of the Delaware River.[35] During the War of 1812, an American ammunition chest accidentally exploded during a British attack on Fort Erie, Canada. This caused the attack to collapse, and the fear of additional fougasses prevented further British attacks.[36] (The only engineer unit in the American Army during this war—the Company of Sappers, Miners and Bombardiers—fought in this battle). During the Mexican-American War of 1845, the Mexicans attempted to employ fougasses on the approaches to Chapultepec.[37] Stone fougasses are still employed occasionally by irregular forces, such as the Viet Cong, Central American guerillas,[38] and Bosnians,[39] who lack access to modern land mines.

Self-Contained Mines

Military engineers in China employed the first self-contained explosive AP mines against Kublai Khan's Mongol invaders in 1277. Manufactured in many shapes and sizes, these mines could be command-detonated or activated with either a pressure device (probably based on a match) or a pull-firing device (a forerunner of the flintlock mechanism).[40] However, they were seldom used and were largely forgotten by the time Western explorers arrived in the Orient.

Introduction of the European flintlock in 1547 led to the first target-activated AP mine in the West. This *fladdermine,* developed by Samuel Zimmermann of Augsburg in 1573, consisted of one or more pounds of black powder buried at a shallow depth in the glacis of a fortress. It was actuated by stepping on it or by tripping a wire along the ground that released a flintlock igniter to fire the main charge. Like the fougasse, these devices were highly vulnerable to dampness and required frequent maintenance. They were used mainly around fixed fortifications.[41] Fladdermines were used against Frederick the Great during the Siege of Schweidnitz in 1758 and by the Germans during the Franco-Prussian War in 1870-1871.[42]

Although the Chinese first introduced explosive shells (as opposed to solid shot) in about 1221, they were unreliable and were used mainly with mortars. Re-introduction of explosive shells in the West in the 1700s, combined with the invention of the percussion cap by Reverend Alexander Forsythe of Scotland in 1814,[43] made possible the next important step in the development of reliable mines by greatly improving their resistance to moisture. Confederate soldiers under General Gabriel Raines improvised the first of this type of AP mine from artillery shells at Redoubt No. 4 near Yorktown, Virginia, during the campaign of 1862.[44] After several casualties, these were cleared by two companies from the 50th New York Volunteer Engineer Regiment.[45] By the end of the Civil War, the Confederates had emplaced thousands of *land torpedoes* around Richmond, Charleston, Mobile, Savannah, and Wilmington, which produced hundreds of casualties (see table on page 53). Robert E. Lee, John Mosby, and J.E.B. Stuart all advocated the use of AP mines.

Land torpedoes were also used against Sherman in Mississippi, by General Raines on roads into Augusta, and by General Wheeler on the roads into Savannah and Pocotaglio. A *coal torpedo* (a type of boobytrap with an irregular sheet-iron case filled with black powder and painted black) was used to destroy General Butler's headquarters steamer *Greyhound,* and coal torpedoes were implicated in the sinkings of the *Chenango* and the *Sultana.* Union troops of I Company, 3rd U.S. Colored Troops, also used torpedoes near Savannah. Five of the torpedoes designed by General Raines were found near Mobile, Alabama, in 1960.

The British employed mines during the Boer War in 1901 to protect railroads and deny fording sites to the enemy.[46] In the Siege of Port Arthur during the Russo-Japanese War of 1904, the Japanese tried to breach Russian mines with volunteer suicide squads that were to force a passage by sacrificing their own bodies. Upon approaching the minefield, the volunteers found that heavy rains had exposed many of the mines.[47]

Between the Civil War and World War I, powerful military explosives were introduced that significantly increased the mines' lethality. Black powder shells of the Civil War period burst into only two to five fragments, while those of the Franco-Prussian War burst into 20 to 30 fragments. By World War I, a 3-inch high-explosive shell produced about 1,000 high-velocity fragments.[48]

The German *tretmine* (step-on mine), the next high-explosive mine to appear, went into limited production before World War I. Lieutenant Ernst Junger of the 73rd Hanoverian Fusilier Regiment described German improvised mines this way: "These hotheads are forever puzzling out the possible ways of ...making the ground in front of the trench murderous with explosive machines. Perhaps they cut a narrow passage through the wire in front of their posts in order to entice an enemy patrol, by this bait of an easy way through, straight up to their rifles."[49]

The United States also had a fairly advanced concept of landmine warfare, as stated in *Engineer Field Manual, Parts I-VII,* in 1918.[50] However, all the World War I combatants relied heavily on artillery and machine guns and seldom used AP mines. It was not until the Second World War that AP mines reached full maturity, and they have been an important facet of almost every conflict since.

Fragmenting AP Mines

Even though modern, self-contained fragmenting AP mines have been employed in the West in relatively small numbers since the American Civil War, they did not appear in significant numbers until World War II. At that time, three types of fragmenting AP mines emerged: *bounding mines,* the predecessors of the M16 "Bouncing Betty"; *directional*

Civil War Landmine (Torpedo) Employment

Location	Type/Number	Effect/Result	Date
Columbus, KY	Improvised electrically command-detonated 4-pound shell filled with grapeshot and two bushels of powder in a cast-iron container	None; visually detected and cleared by a company from the 27th Illinois Infantry	March 1862
Redoubt No.4, Williamsburg, VA	A few shells with pressure or trip-wire fuzes	Marked with small red flags; caused about 36 casualties including some killed in action	4 May 1862
Road out of Williamsburg, VA	Four 10-inch shells with trip-wire fuzes near felled trees	Union cavalry took "some" casualties; caused a three-day delay	5 May 1862
Fredericksburg, VA	Railroad mines with percussion fuzes	None; "contrabands" identified their location and cleared the mines by hand. Proofed by a flat car pushed slowly ahead of the locomotive.	May 1862
Nashville and Chattanooga Railroad near Tullahoma, TN	Railroad mines laid by CPT McDaniel	Two "heavily laden" trains were destroyed	27 June 1863
Battery Wagner, SC	Many, including 56 10-inch shells, about 20 24-powder, more than 30 10-gallon wooden kegs, and three 15-inch naval shells	At least seven were exploded, killing two and wounding 11	Summer 1863
Fort Esperanza, TX	24 improvised 40-pound torpedoes, electrically command-detonated	Discovered after the fort was captured	Fall 1863
James Island, SC	Land torpedoes and flame mines reported	Union troops avoided the area	1864
City Point, VA	One 12-pound clockwork torpedo brought aboard an ammunition barge	At least 58 killed, 126 wounded, $4 million in damages	9 August 1864
West Point Railroad south of Atlanta, GA	Sherman's troops emplaced pressure fuzed mines during railroad destruction	Unknown	28 August 1864
Fort McAllister, GA	7- or 8-inch shells 3 feet apart	12 killed and about 80 wounded	13 December 1864
Fort Fisher, NC	24 electrically command-detonated Singer torpedoes, 200 feet in front of the trenches around the fort, 80 feet apart	Firing wires cut by artillery fire	22 January 1865
Sister's Ferry, GA	James Tomb laid 40 to 50 torpedoes using 6- and 10-powder shells	Two exploded and killed "several" of Sherman's men	29 January 1865
Richmond, VA	At least 1,298 mines	Delayed Union General Weitzel's XVIII Corps' advance by several hours	April 1865
Spanish Fort, AL	205 Raines mines	"Several" killed	9 April 1865
TOTAL	**Thousands of mines laid**	**Hundreds of casualties**	

mines, the predecessors to the M18 Claymore; and *simple fragmenting mines,* like the Soviet POMZ-2 stake mine.

Bounding AP Mines. An 1859 U.S. military engineering manual by General Halleck includes the design for an improvised command-detonated bounding AP mine called a *shell fougasse.*[51] However, modern manufactured examples of this type did not make their combat debut until early in World War II, when French patrols on the Siegfried Line began to take unexplained casualties. These casualties were attributed to a device the French dubbed "the silent soldier," the famous German "S" mine introduced during the 1930s.[52] These mines were commonly called *"Bouncing Bettys."*

Directional AP Mines. These mines descended from an early directional type of stone fougasse used in Europe. Under the guidance of physicists Franz Rudolf Tomanek and Hubertn Schardin, the Germans developed a directional AP mine, called a *trench mine,* late in World War II. The French fielded a directional AP mine in 1947, but it was the Americans who refined it in response to the human-wave attacks of Chinese Communist forces during the Korean Conflict in the early 1950s. The new mine was developed and placed in production in 1953, too late to see combat in Korea. Called the M18 Claymore after a famous type of Scottish broadsword, it first saw combat in Vietnam in 1961.[53]

Simple Fragmenting AP Mines. Stake-mounted, fragmenting AP mines were introduced in the Russo-Finnish War of 1939, when badly outnumbered Finns improvised them from grenades. When the Finns fought the Russians to a standstill along the Mannerheim Line in November 1939, this setback forced the Russians to conduct the first mounted breach of a mined, complex obstacle. In preparation for a deliberate breach, the Russians improvised roller tanks and flamethrower tanks and conducted extensive rehearsals.[54] The *stake mine* that emerged from World War II is still used today without significant changes to its design.[55] The best-known example is the Soviet-made POMZ-2 mine.

Blast AP Mines

Blast AP mines descended from the vertical fougasse and large underground mines that were dug under fortified positions and then detonated. It is unclear which mine is the first modern "toe-popper" blast AP mine, but the Soviet-made PMK-40[56] and the British-made "Ointment Box"[57] mine are good candidates.

Chemical Mines

The British-developed Livens Projector was first employed in 1917 and is arguably the first chemical mine.[58] The Germans also developed and employed what the Allies dubbed the "Yperite Mine" in 1918. It used a delayed action demolition charge containing mustard agent ("Yperite") to deny bunkers that were being abandoned during a withdrawal.[59] The first modern chemical mine, the Spruh-buchse 37 (Bounding Gas Mine 37), was developed and produced by Germany during World War II and normally had a mustard-agent fill. It was never used in combat.[60] Except for the introduction of nerve-agent fills, the design of chemical mines has not changed significantly since the Second World War.

Flame Mines

"Liquid Fire" and "Greek Fire" have existed since classical times. However, the first reported flame mine was improvised by Confederate soldiers near Charleston in 1864, possibly from shells containing Greek Fire, which the Union fired into the city and that failed to function.[61] During World War II, the Russians used a trip-wire-activated static flamethrower at the Battle of Kursk.[62] These devices were quickly copied by the Germans and used in the Atlantic Wall.[63] The British also employed improvised flame mines during the First Battle of El Alamein in 1942.[64] The United States developed the first modern flame mine, the XM-55, for use in Vietnam. It was a pressure- or trip-wire-activated bounding mine.[65] There are no indications that it was ever used in combat. Improvised flame mines, sometimes called *flame fougasse,* are still occasionally used in combat.

Boobytraps

The first explosive boobytraps were employed by the Chinese against the Mongols in 1277.[66] They first appeared in the West during the Seminole War of 1840.[67] During the Civil War, Confederate soldiers employed a variety of these devices—including pull-firing devices, timer-rundown fuzes, and coal or wood "torpedoes" that detonated when burned in a boiler. Boobytraps reached full maturity during World War II, when reliable German mechanical anti-handling devices were introduced, and have been used in almost every conflict since.

Conclusion

During the 20th century, the antipersonnel mine evolved into a highly effective weapon and combat multiplier. It proved to have great utility for protecting outnumbered American soldiers against dismounted attacks, as shown in Anzio and Korea. The innovations that made this mine possible came from a variety of sources, including the ingenuity of combat engineers.

Part II of this article begins with antivehicle mines, first used around 120 B.C., and continues through countermines, sea mines, and antiaircraft mines being used or developed today.

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Endnotes

[1] *Ancient Inventions,* by Peter James and Nick Thorpe, Ballantine Books, New York, page 200.

[2] *A History of Fortification, From 3000 BC to AD 1700*, by Sidney Toy, Heineman, London, 1966, page 2.

[3] *The Generalship of Alexander the Great,* by J.F.C. Fuller, Rutgers University Press, New Brunswick, N. J., 1960, page 45.

[4] *Origins, A Short Etymological Dictionary of Modern English,* by Eric Partridge, the Macmillan Company, New York, 1966, page 251.

[5] OP CIT, *A History of Fortification, From 3000 BC to AD 1700*, page 256.

[6] *The Art of Warfare in Biblical Lands, Volume 1,* by Yigael Yadin, McGraw-Hill Book Company, New York, page 317. Note however, that the earliest mention of engineer soldiers is attributed to the Hittites as early as 1600 BC. Also, the early Hittite capital Boghazkoy had predug tunnels to allow for defensive sorties against any prospective besiegers. See The Hittites, by O. R. Gurney, Penquin Books.

[7] OP CIT, *The Generalship of Alexander the Great,* pages 200-218.

[8] *War Commentaries of Caesar,* by Julius Caesar, translated by Rex Warner, The New American Library, 1960, pages 259-266.

[9] *Warfare in Antiquity, The History of the Art of War, Volume 1,* By Hans Delbruck, translates by Walter Renfroe, University of Nebraska Press, Lincoln, Nebraska, 1990 edition, page 212. See also "Weaponry," by Robert W. Reid, Military History Magazine, August 1998, page 20.

[10] OP CIT, *War Commentaries of Caesar,* page 173.

[11] *The Face of Battle,* by John Keegan, Penquin Books, 1976, pages 90-91.

[12] *The Genius of China,* by Robert Temple, Simon and Schuster, New York, 1986, page 224.

[13] "Mongol Invasion of Europe," by Erik Hildinger, *Military History Magazine,* June 1997, page 44.

[14] OP CIT, Origins, *A Short Etymological Dictionary of Modern English,* page 271.

[15] *The Complete Illustrated Encyclopedia of the World's Firearms,* by Ian V. Hogg, A & W Publishers, New York, page 8.

[16] *Mine/Countermine Operations at the Company Level,* FM 20-32, Department of Doctrine and Training Development, US Army Engineer School, Fort Belvoir, Virginia, 30 September 1976, page 133.

[17] *Engineers of the Renaissance,* by Bertrand Gille, The MIT Press, Cambridge, Massachusetts, page 124-125.

[18] *A History of Artillery,* by Ian V. Hogg, Hamlyn, New York, pages 23-24. The entire English inventory was only 84 pounds of powder in 1370.

[19] As portrayed during the siege of Harfleur (1415) in Shakespeare's play "Henry V."

[20] *A Manual of Siegecraft and Fortification,* Sebatien de Vauban, translated by George Rothrock, The University of Michigan Press, 1968.

[21] "Siege," by Gert Bode, *International Military and Defense Encyclopedia, Volume 5,* Brassey's Inc., Washington, D.C., 1993, page 2421.

[22] *Military Explosives,* TM 9-1300-214, Department of the Army, September 1984, pages 2-4 to 2-8.

[23] Although Count Volta invented his "voltic pile" battery in 1800, its potential utility was only slowly recognized.

[24] *War Underground, The Tunnellers of the Great War,* by Alexander Barrie, Tom Donovan, London, England, pages 196-206.

[25] *An Elementary Course of Military Engineering. Part I. Comprising Field Fortification, Military Mining, and Siege Operations,* By D. H. Mahan, Wiley & Son, New York, New York, 1867, pages 172-177.

[26] "Engineer Operations During the Vicksburg Campaign," by Robert Puckett, AD-A255-141, Ft Leavenworth, KS, 1992, pages 124-132.

[27] *The Siege of Petersburg,* by Joseph P. Cullen, Eastern Acorn Press, 1970, pages 17-23. The mine exploded by Federal troops under the Confederate earthwork at Elliot's Salient at Petersburg, Virginia, on 30 July 1864 was 510 feet long, charged with 8,000 pounds of powder and produced a crater 9 meters (30ft) deep, 18 meters (60ft) wide, and 52 meters (170ft) long. The subsequent Federal assault, however, was unable to exploit the temporary advantage gained by the explosion and the surprise. A work force reaching over 400 men at times completed the mine in slightly over a month.

[28] *The History of Fortification,* by Ian Hogg, St. Martin's Press, New York, pages 185-189.

[29] OP CIT, *War Underground, The Tunnellers of the Great War,* pages 243-261. On 7 June 1917 British engineers fired nineteen mines with 430 tons of Ammonal at a depth of 40 meters at Wytschaete Salient south of Ypres, destroying three German battalions.

[30] On 13 March 1918, Austrian engineers blew up part of Mount Pasubio, which was occupied by the Italians, using 50,000 kilograms (55tons) of explosives killing 485 men.

[31] *Small Unit Actions During the German Campaign in Russia,* CMH Pub 104-22, Center of Military History, Washington, D.C., Facsimile edition 1988, pages 165-168). The "Blitzkrieg" oriented German Army of WWII maintained special "Minier Pioniere" units throughout the war (Pioniere, Entwicklung einer Deutschen Waffengattung, by Dietrich Petter, Wehr und Wissen Verlagsgesellschaft MBH, Darmstadt, Germany, 1963, page 245). The British and Canadians are retained this type of unit during WWII.

[32] *Hell in a Very Small Place,* by Bernard Fall, J.B. Lippincott Company, 1966, pages 384-386.

[33] Not to be confused with the improvised flame mine that US Army engineers occasionally employ and call a "fougasse."

[34] *Frederick the Great, On the Art of War,* by Frederick II, edited and translated by Jay Luvaas, copyright 1966, The Free Press, New York, page 288.

[35] *Engineers of Independence, A Documentary History of the Army Engineers in the American Revolution, 1775-1783,* by Paul K. Walker, Historical Division, Office of the Chief of Engineers, Washington, D.C., page 158-159

[36] *Campaigns of the War of 1812-15 Against Great Britain, Sketched and Critised; with Brief Biographies of the American Engineers,* by MG George Cullum, James Miller, New York, 1879, pages 237-250.

[37] *The War with Mexico,* by Donald Chidsey, Crown Publishers, New York, pages 161-163.

[38] *Ayudas de Instruccion Contra Minas, Trampas Y Artefactos Explosivos,* Guatemalan Corps of Engineers, undated, page 60.

[39] *Engineer Contingency Handbook* (former Yugoslavia), US Army Engineer School, Ft Leonard Wood, Missouri, July 1993, page 1-32.

[40] OP CIT, *The Genius of China,* page 235-237.

[41] "Mine Warfare, Land," by Ulrich Kreuzfeld, *International Military and Defence Encyclopedia, Volume 4,* Brassey's Inc., Washington, D. C., 1993, pages 1756-1757.

[42] OP CIT, *Pioniere, Entwicklung einer Deutschen Waffengattung,* pages 36 and 118.

[43] *The Illustrated Encyclopedia of 19th Century Firearms,* by Major F. Myatt, Cresent Books, New York, page 18.

[44] *Lee's Lieutenant's, Volume 1,* Douglas Southall Freeman, 1942, pages 268-269. See also Southern Historical Society Papers, Volume III, January to June 1877, Broadfoot Publishing Company, 1990 edition, pages 38-39. The shells used were ordinary 8- or 10-inch mortar or columbiad shells.

[45] *Bridge Building in Wartime, Colonel Wesley Brainerd's Memoir of the 50th New York Volunteer Engineers,* edited by Ed Malles, University of Tennessee Press, Knoxville, Tennessee, 1997, page 65.

[46] "The Royal Engineers Journal," December 1, 1903, page 267.

[47] *The Short Victorious War, The Russo-Japanese Conflict, 1904-5,* by David Walder, Harper & Row, New York, page 102.

[48] *The Evolution of Weapons and Warfare,* by T. N. Dupuy, Bobbs-Merrill Company, Indianapolis, 1980, page 213.

[49] *The Storm of Steel, From the Diary of a German Storm-troop Officer on the Western Front,* by Ernst Junger, Howard Fertig, New York, 1993 edition, page 43.

[50] *Engineer Field Manual, Parts I-VII,* Professional Papers of the Corps of Engineers, US Army, No.29, Fifth Edition (corrected to December 31, 1917), Government Printing Office, Washington, 1918, page 422.

[51] *Elements of Military Art and Science; or, Course of Instruction in Strategy, Fortification, Tactics of Battle &c,* by H. Wager Halleck, D. Appleton & Company, New York, New York, 1859, page 363. Note however, that this type probably predates this work and in fact, it may be shell fougasses that were emplaced by the Mexicans at Chapultepec, but the available descriptions are not clear.

[52] *Engineers in Battle,* by Paul W. Thompson, Military Service Publishing Company, Harrisburg, Pennsylvania, 1942, pages 64-71, translation of an article in Vierteljahreshefte fur Pioniere, 3rd Quarter, 1940.

[53] *Claymore Mines, Their History and Development,* by Larry Grupp, Paladin Press, Boulder, Colorado, 1993.

[54] *The Winter War, The Russo-Finnish Conflict, 1939-40,* by Eloise Engle and Lauri Paananen, Charles Scribner's Sons, New York.

[55] *Eastern Europe, World War II, Landmine and Countermine Warfare,* Engineer Agency for Resources Inventories, Washington, D.C., August 1973, page 155.

[56] *Soviet Mine Warfare Equipment,* TM 5-223A, Department of the Army, Washington, D.C., August 1951, page 129.

[57] *British, French and Italian Mine Warfare Equipment,* TM 5-223D, Department of the Army, Washington, D.C., May 1952, page 61.

[58] *Chemical Warfare in World War I: The American Experience, 1917-1918,* by Charles Heller, Leavenworth Papers No. 10, Combat Studies Institute, Ft Leavenworth, Kansas, September 1984, page 20-21.

[59] "Report on an Yperite Mine," Report No. Z-741, by A. Kling, Municipal Chemical Laboratory, Paris, France, 3 December 1918, DTIC # AD499336.

[60] *German Mine Warfare Equipment,* TM 5-223C, Department of the Army, Washington, D.C., March 1952, page 146.

[61] *Infernal Machines, The Story of Confederate Submarine and Mine Warfare,* by Milton F. Perry, Louisiana State University Press, 1965, page 166.

[62] *The History of the Panzerkorps Grossdeutschland, Volume 2,* by Helmuth Spaeter, J. J. Fedorowicz Publishing, Winnipeg, Canada, 1995 edition, page 121.

[63] OP CIT, *Eastern Europe, World War II, Landmine and Countermine Warfare,* pages 387-399. For an example of their use in the Atlantic Wall, see "Defenses of the Normandy Peninsula," by Sherwood Smith, The Military Engineer, Vol. XXXVII, No. 2, page 50.

[64] Report from the 3rd Reconnaissance Battalion, 21st Panzer Division, dated 26 July 1942, Captured German Records, National Archives, T-313, Roll 431, Frame 8723884.

[65] *Vietnam, 1964-1969, Landmine and Countermine Warfare,* Engineer Agency for Resources Inventories, Washington, D.C., June 1972, page 47.

[66] OP CIT, *Ancient Inventions,* page 207.

[67] *Southern Historical Society Papers, Volume X, January to December 1882,* Broadfoot Publishing Company, 1990, pages 257-260.

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Maneuver Support Center (MANSCEN)

MANSCEN Events. The initiative to stand up the MANSCEN at Fort Leonard Wood is on track. The following events indicate progress to date:

- MG Flowers was appointed the provisional MANSCEN Commander by General Hartzog, TRADOC Commander, effective 30 April 1998.
- Garrison Command is preparing the Reception Plan, which will be completed by 1 October 1998.
- Final plans for integrating Fort McClellan elements into Fort Leonard Wood facilities are under way. Many organizations will move within the schoolhouse and telephone numbers will change. New telephone numbers will be listed on the Fort Leonard Wood LAN system.
- Construction of new facilities is on schedule. Anticipated occupancy dates are being finalized, which will affect the procurement of furniture and the installation of communications and data lines.
- The Chemical Defense Training Facility will begin surety training and testing in January 1999.
- MANSCEN training begins in June 1999.

Additional information is available on the MANSCEN home page at:
www.wood.army.mil/manscen/index.htm
POC is LTC Susan Myers, -6134.

Department of Training and Doctrine (DOTD)

Field Manual Update. Engineer School personnel recently digitized several field manuals that are not currently available in the Army Doctrinal and Training Digital Library. These manuals are posted to the Engineer School's Publications Page at http://www.wood.army.mil/PUBS/newpubs.htm.

The Engineer School is reviewing the first draft of the next iteration of doctrine to support Force XXI operations. This doctrine will be published as changes to existing manuals.

The following manuals are scheduled for publication and release to the field within the next 180 days.

- FM 5-116, *Engineer Operations: Echelons Above Corps*
- FM 5-34, *Engineer Field Data*
- FM 5-436, *Paving and Surfacing Operations*
- FM 5-415, *Fire Fighting Operations*
- FM 5-434, *Earth Moving Equipment*
- FM 90-13-1, *Combined Arms Breaching Operations*
- FM 90-7, *Combined Arms Obstacle Integration*

POC is Sandra Gibson, -4100.

Directorate of Combat Developments (DCD)

M34 Blasting Machine. A Safety of Use Message (SOUM ACALA 98-05) from the Tank and Automative Command (TACOM) deadlines the M34 Blasting Machines manufactured by Minowitz Manufacturing. The M34 is a component of Demolition Kit (LIN F91490) and EOD Field Maintenance Set (LIN T57126) and is used with the MICLIC (LIN 67342). If you have a Minowitz M34 Blasting Machine or a blasting machine that cannot be identified as manufactured by a company other than Minowitz, it must be removed from service until it is tested. A blasting cap connected to the machine can be detonated by voltage produced when the bail lock is released and the handle of the blasting machine is extended to the "ready" position. Minowitz M34 Blasting Machines are identified by a lot number beginning with "MMW" that is etched or stamped on the bottom. To obtain a detailed test procedure from TACOM, call the Logistics Management Office at Rock Island Arsenal at (309) 782-1709 or DSN 793-1709. POC is Alan Schlie, -6191.

Nuclear Densimeter. The contract award for a new nuclear densimeter is scheduled for July 1998, with the date of issue programmed for the 4th quarter of FY99. An article describing the equipment and the responsibilities of the using unit commander will appear in the fall issue of *Engineer*. POC is SSG Troy Miller, -6185.

Lead the Way

By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School

ENFORCE Conference

Another ENFORCE Conference has come and gone. By all accounts, this was a great one. All of us at the Engineer Center appreciate your efforts and the support you provided. Now it's time to look ahead.

Change

Our Army is an institution that constantly changes. Reasons include changes in our National Policy, the impacts of changing resources (people, funding, etc.), and technological advances. All of us are impacted, but some feel the effects of change more than others. As noncommissioned officers, it is our responsibility to remain positive about changing conditions and to give leaders our ideas and opinions concerning proposed changes. You can address your ideas and opinions to Army leaders through the chain of command and to the Engineer Center, which is your "voice" on issues related to changes in engineer doctrine, force structure, equipment modernization, and training. We value your input and, frankly, we can't do without it. Input to the chain of command and the Engineer Center is a positive way you can affect change.

At the same time, we must shelter our subordinates from negative, nonproductive discussions about change. As noncommissioned officers, we must remain focused on training, maintenance, quality of life issues, and mentoring. We must help our soldiers focus on what is truly important. If we do this, the impacts of change will be reduced and less noticeable to our soldiers. We must help them adjust to required changes and ensure they remain focused on what is truly important: training, maintenance, and career development.

Command Sergeants Major Fall Engineer Training Conference

As you may have heard, a Command Sergeants Major Training Conference will be held in Vicksburg, Mississippi, on 20-22 October. If you have not received an invitation and would like to attend, please send an e-mail message to: dilsr@wood.army.mil. Invitation packets will be mailed by 15 August 1998. A very informative program is planned and we look forward to seeing you.

In preparation for this training conference, we ask that you complete one of the three surveys posted on the Fort Leonard Wood home page (www.wood.army.mil). Separate surveys are posted for NCOs in career management fields (CMFs) 12, 51, and 81. We ask that you complete the survey no later than 1 September.

Engineers Lead the Way!

We extend a big "Hoo-ah!" to the following individuals for their outstanding achievements:

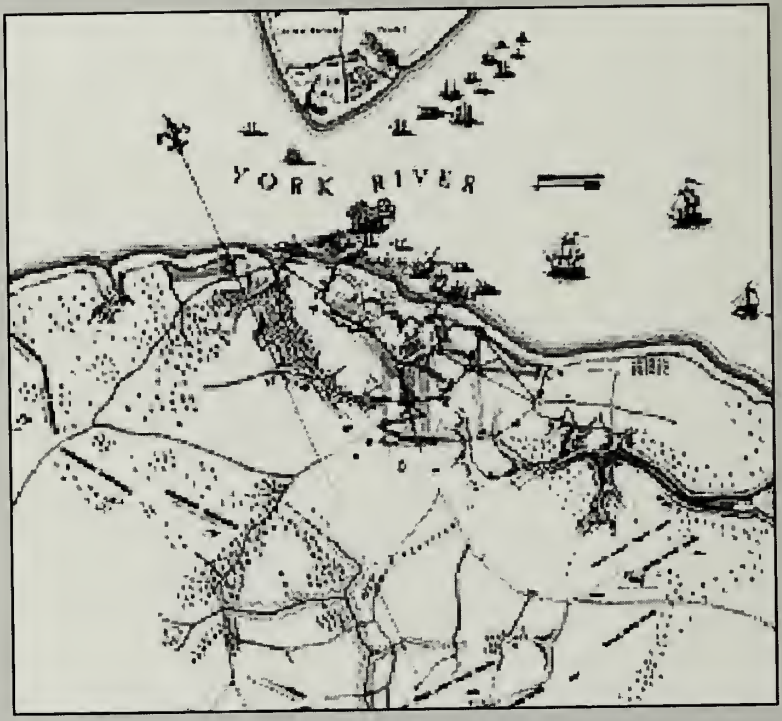
- Specialist Jason D. Etling, 642nd Engineer Company, 41st Engineer Battalion, 10th Mountain Division, Fort Drum, New York, is the Division Soldier of the Quarter for the 2nd quarter, FY98.
- Sergeant John W. Swartz, D Company, 10th Engineer Battalion, 3rd Infantry Division, Fort Stewart, Georgia, is the Division NCO of the Quarter for the 2nd quarter, FY98.
- SSG Bradley J. Houston, 12B, Fort Leonard Wood's Drill Sergeant of the Year, was recently selected to be the United States Army Active Component Drill Sergeant of the Year.
- SSG Thomas J. Ross, 12B, 98th Training Division Drill Sergeant of the Year, was recently selected to be the runner-up for the United States Army Reserve Component Drill Sergeant of the Year.
- SPC Mack H. Welch, 12B, C Company, 16th Engineer Battalion, Engineer Brigade, 1st Armored Division, was selected to be the United States Army Europe (USAREUR) Soldier of the Year for 1998.
- Did you know that the 4th Engineer Battalion, Fort Carson, Colorado, has 12 members of the Sergeant Morales and the Sergeant Audie Murphy Clubs? That significant record will be hard to beat!

Congratulations to you all!

☆ U.S. GOVERNMENT PRINTING OFFICE 1998: 655-120 / 80003

DUTY

"Do your duty in all things. You cannot do more.
You should never wish to do less."
Robert E. Lee



Map of the Yorktown Battle
Showing Engineer Siege Works (October 1788)

"This corps of Miners was reckoned an honorable one ... I was a sergeant and I think I did use my best abilities to perform the duties of the office according to my best knowledge and judgement. Indeed, I can say at this late hour of my life, that my conscience never did, and I trust never will, accuse me of any failure in my duty to my country ... I always fulfilled my engagements to her ..."

Sergeant Joseph Plumb Martin, Company of Sappers and Miners

History Office, U.S. Army Engineer School

[redacted]
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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

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AT URBANA-CHAMPAIGN

November 1998

Preparing for the next millenium

Headquarters, Department of the Army
PB 5-98-4 Approved for public release, distribution is unlimited

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CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

The slogan *"One Regiment, One Team, One Fight"* embodies the Engineer Regiment's vision. The Senior Engineer Officer Board of Directors carefully crafted the vision in Washington, D.C., in September. Its purpose is to ensure that our regiment remains relevant to all our military forces, major Army command (MACOM) staffs, Directors of Public Works, Department of Defense civilians, private industries that serve or support military units, and Corps of Engineer organizations around the world. The vision statement describes how an organization will look, what it will do, and how it will operate. It states what we continually strive to achieve. Our new vision statement is:

The U.S. Army Engineer Regiment

The World's Premier Engineer Team:

- Full-Spectrum, Total Force—Vital to the Army and the Nation
- Values Based – Respected, Responsive, Reliable
- Visualizing and Enhancing Terrain to Ensure Mission Success
- Meeting Tomorrow's Challenges Today – Deployed or at Home, in Peace or in War

One Regiment, One Team, One Fight

Our next step is to staff this vision statement with regimental leaders at all levels to gain an understanding of what each bullet means to the various organizations within the regiment. As stated during the 1998 ENFORCE Conference, the vision is effective only if the officers, noncommissioned officers, and Department of the Army civilians understand it. To that end, I ask all of you to continually communicate this vision to soldiers and civilians throughout our diverse regiment.

The Engineer School continues to field new equipment to maintain a vital force structure. Our top five priorities remain the Grizzly, the Wolverine, the Digital Topographic Support System (DTSS), the Maneuver Control System-Engineer (MCS-ENG), and a modernized engineer squad vehicle (ESV). I ask your support to communicate the importance of these systems to key Army, Department of Defense, and political leaders. Brief descriptions follow.

The Grizzly is a complex obstacle-breaching vehicle that is based on a refurbished M1 chassis. It integrates advanced countermine and counterobstacle capabilities in a single, survivable system.

The Wolverine is a heavy assault bridge that is based on an M1 chassis. It is designed to transport, launch, and retrieve a military load class 70 bridge across gaps up to 24 meters.

The DTSS integrates commercial off-the-shelf hardware and laboratory-developed software to form a package that provides direct access to data acquired by national systems and delivered by tactical exploitation of national capabilities assets. Soldiers utilizing the DTSS have the capability to produce soft and hard topographic products, such as digital terrain elevation data map substitutes and three-dimensional terrain products.

MCS-ENG is an engineer-specific software system that is subordinate to the Maneuver Control System (MCS). The MCS is a command and control system that provides the maneuver commander and his staff (Corps level and below) with automated assistance to execute precise, near real-time command and control of combat forces.

A modernized ESV is critically needed to enhance engineer survivability and give engineer units an armored capability for providing mobility and countermobility support to the maneuver forces. The leading contender for a modernized ESV is the Bradley fighting vehicle. The long-term solution is to co-develop an ESV variant of the future infantry vehicle (see article, page 7).

As part of OPMS XXI, we recently updated the Engineer chapter in DA Pam 600-3. The most significant change expands opportunities for majors to become branch qualified. Branch-qualifying positions for majors now include assistant division engineers, directors of public works, and deputy district engineers, as well as the traditional S3 and XO positions. This change recognizes the importance that these positions have in supporting the total force and the considerable responsibility they demand. I believe that this change will result in officers spending more time in branch-qualifying positions for the betterment of the organization and themselves.

As I travel around the world and visit military units, I have an opportunity to meet some of the outstanding soldiers, sailors, airmen, and Marines who trained here at Fort Leonard Wood. I never fail to be amazed at their high quality. Thank you for a job well done.

Engineer

November 1998 Headquarters, Department of the Army *Volume 28 PB 5-98-4*

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

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05173

Front Cover: *Through Army XXI reorganization, experimentation, deployments, and training, engineers prepare for the next millenium.*

Back Cover: *A historical example of the Army value "Respect."*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 370, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 370, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER's e-mail address is: eubanksc@wood.army.mil. Our Internet home page is located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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The Army XXI Division:

Engineer Relevancy in the Age of Information Technology

By Major General Robert B. Flowers, Mr. Vern Lowrey, and Colonel Bruce Porter

Engineers continue to prove their professional excellence and relevance in ongoing missions and training throughout the world. Today, Army engineers are deployed in more than 70 countries to support operations ranging from building roads to clearing landmines to producing terrain visualization products. In the coming months and years, Army engineers have yet another challenge to meet—the Army XXI division (see Figure 1).

Since 1993, the Training and Doctrine Command (TRADOC) has been in the process of restructuring for tomorrow's Army. Through numerous seminars, analyses, and Advanced Warfighting Experiments, we designed a new heavy division. In June 1998, Army Chief of Staff General Reimer approved the Army XXI division design, which will be fielded initially by the 4th Infantry Division at Fort Hood, Texas. The division will reorganize starting in October 1998 and will be evaluated during a series of experiments and exercises that culminate in a Division Capstone Exercise (DCX) to validate the design sometime during the summer of 2001.

The U.S. Army Engineer School will thoroughly evaluate the 4th Infantry Division engineer structure from now through the DCX. The school will properly collect and analyze data that may lead to appropriate recommendations to the Army Chief of Staff concerning the Army XXI engineer structure. **The school does not support efforts to convert other heavy divisions to the Army XXI structure until the design has been thoroughly evaluated by the Army and appropriate enablers are available.**

TRADOC Commander General Hartzog wrote in the July-August 1998 issue of *Army RD&A* that this design is "...unique because of its smaller size (about 15,000 soldiers), its smaller and more compact combat elements (45 combat platforms in

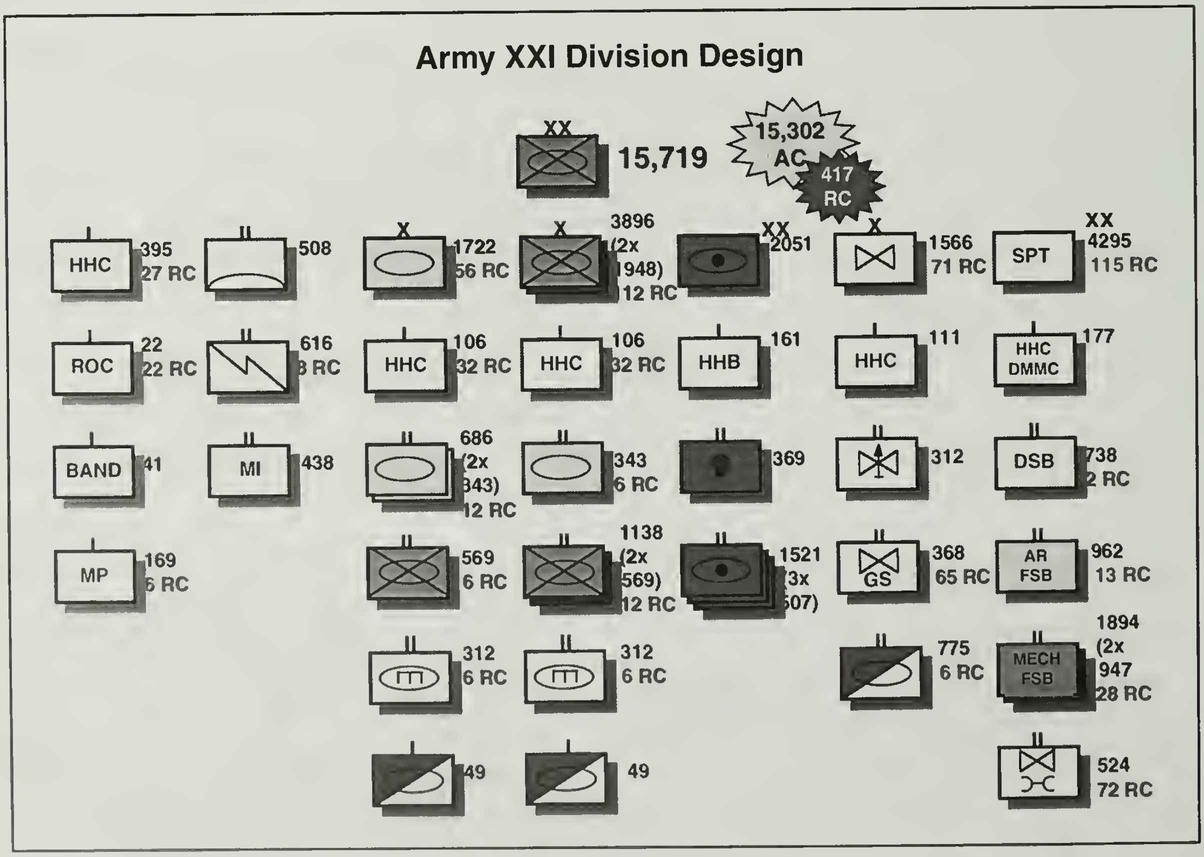


Figure 1

> *"Let me emphasize to everyone that the loss of the division engineer brigade headquarters in the Army XXI division design is not a "done deal!" The Engineer School will continue to gather evidence through ongoing experimentation. We critically need help NOW from engineer commanders in the field to help retain the engineer brigade structure in the Army XXI and other heavy divisions in the future. We ask that you work your recommendations through your major Army command headquarters (i.e., FORSCOM, USAREUR, or the National Guard Bureau) to the Army Chief of Staff. We also ask that you keep key Engineer School personnel informed of your actions. We must work together to achieve our common goal."*
>
> *Major General Robert B. Flowers*

maneuver battalions), and its reliance upon digital technology and computers. Its size makes it more rapidly deployable. Its ability to share information horizontally and vertically across the battlefield makes it capable of sustaining a rapid tempo of planning, preparing, and executing operations as well as sustaining and recovering from operations. Its modular organization contributes to its versatility for specific missions. The division is agile and lethal and increases warfighter survivability, and it has the organizational capability for what is called "mental agility."

Army XXI Division Engineer Structure

The Army XXI division has three major changes in engineer structure compared to the current Army of Excellence division:

- An engineer staff element is part of the division headquarters and headquarters company (HHC)—versus the current separate division engineer brigade headquarters. (The Engineer School's goal remains to reinstate a division engineer brigade headquarters as part of the Army XXI division validation process. We will accomplish this through the DCX.)
- An engineer battalion is assigned to each brigade combat team (BCT) in the division—rather than being assigned to the division engineer brigade headquarters as it is today.
- All combat service support (CSS) (less medical) for the engineer battalion is provided by the base support company (BSC) of the BCT forward support battalion—versus the current engineer battalion with its own CSS.

Doctrinal and Organizational Impacts

Army XXI division engineers will be required to change the way they operate doctrinally based on organizational changes in the Army XXI division design (Figure 2). The major organizational changes affecting doctrine include the division engineer staff element, the division engineer battalion, echelon above division (EAD) engineer support, and CSS operations. Implications of these changes follow.

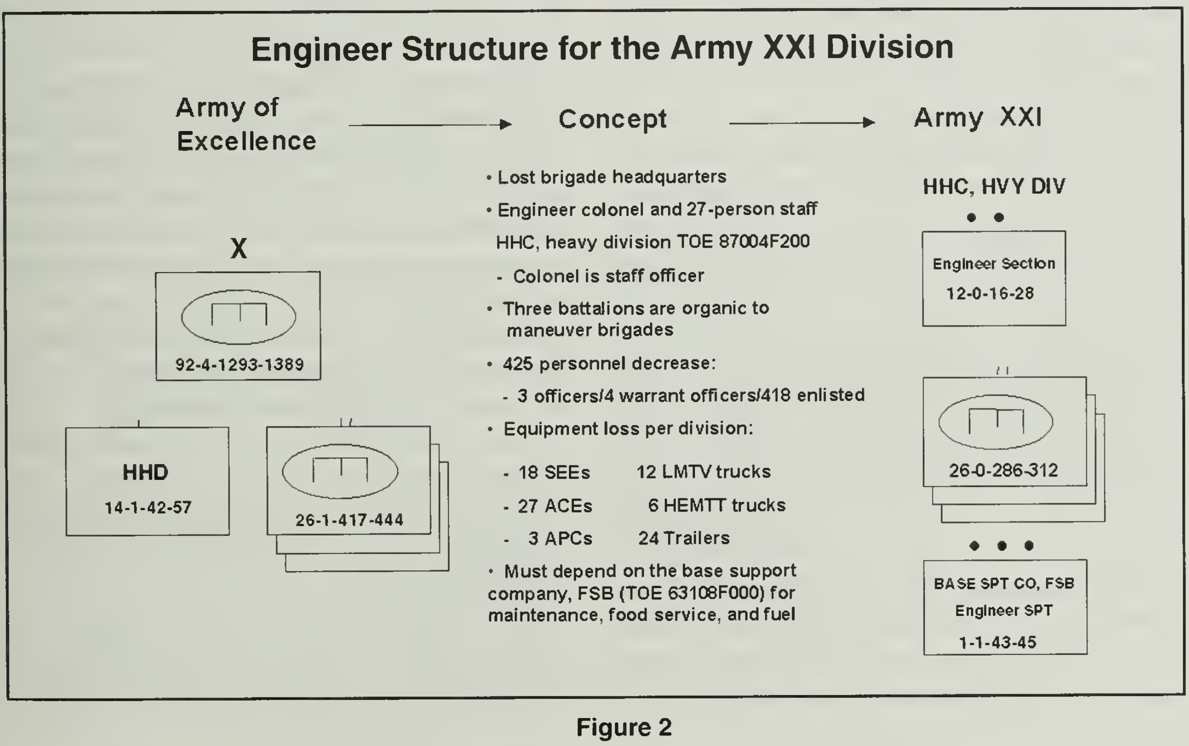

Engineer Structure for the Army XXI Division
Army of Excellence
Concept
Army XXI
X
92-4-1293-1389
HHD
14-1-42-57
26-1-417-444
• Lost brigade headquarters
• Engineer colonel and 27-person staff HHC, heavy division TOE 87004F200
- Colonel is staff officer
• Three battalions are organic to maneuver brigades
• 425 personnel decrease:
- 3 officers/4 warrant officers/418 enlisted
• Equipment loss per division:
- 18 SEEs 12 LMTV trucks
- 27 ACEs 6 HEMTT trucks
- 3 APCs 24 Trailers
• Must depend on the base support company, FSB (TOE 63108F000) for maintenance, food service, and fuel
HHC, HVY DIV
Engineer Section
12-0-16-28
26-0-286-312
BASE SPT CO, FSB
Engineer SPT
1-1-43-45

Figure 2

Division Engineer Staff

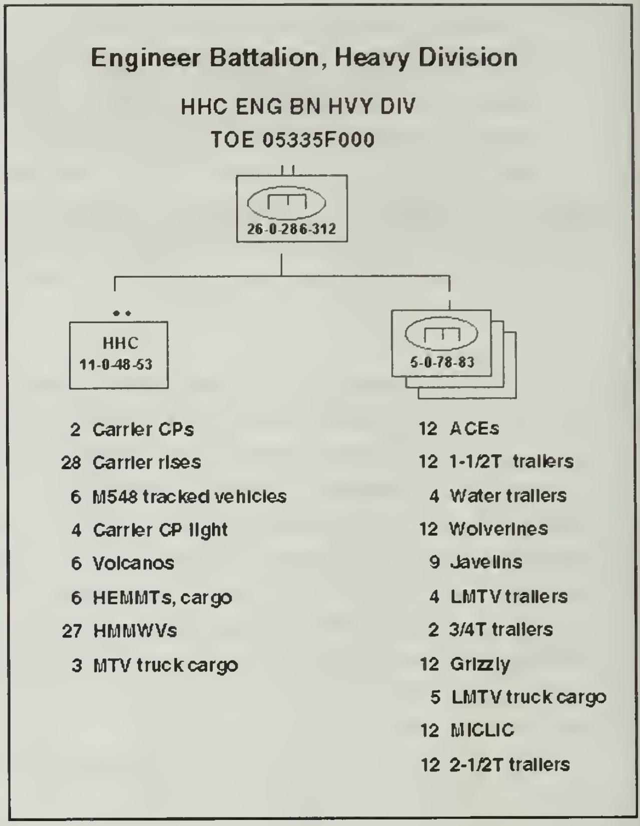
The Army XXI division engineer staff element is under the control of the division engineer officer, who remains a colonel. The engineer staff is embedded in division command posts, currently the tactical and main command posts. The engineer staff provides digital engineer input to division orders and writes the engineer annex. The staff determines additional engineer capabilities needed from EAD based on division requirements. The engineer staff maintains situational understanding of the organic division and augmenting EAD engineer operations through division digital reporting procedures. All engineer staff recommendations flow through the division G3 for action or decision by the division commander. The engineer staff normally works to integrate an engineer command and control headquarters—such as an engineer group (combat), which is task organized from EAD to support the division.

Heavy Division Engineer Battalion

Army XXI division engineer battalions are now under the BCT commander (Figure 3). They support the commander's intent by providing responsive mounted obstacle breaching and emplacement, such as Volcano-scatterable minefields. The Army XXI division engineer battalion is fully mounted and uses Grizzly breachers, Wolverine heavy assault bridging, and M9 armored combat earthmovers (ACEs) in support of brigade offensive operations. The Army XXI engineer battalion no longer has small emplacement excavators (SEEs). It has one less squad per engineer platoon, no tactical command post capability, and fewer ACEs. The engineer battalion can receive additional engineers from EAD for increased obstacle reduction and creation capability, deliberate defensive operations, operations in restricted terrain, lines-of-communication (LOC) construction, and maintenance and repair in the brigade battlespace.

The Engineer School and 4th Infantry Division Engineer Brigade are evaluating the TRADOC-approved concept of using an M2 Bradley fighting vehicle as an engineer squad vehicle to possibly replace the M113A3 armored personnel carrier (APC) in Army XXI division engineer battalions. (See article on page 7.)

The engineer battalion commander is dual-hatted as the brigade engineer and the engineer battalion commander. The engineer battalion provides an assistant brigade engineer staff element that operates in the brigade command post. The ABE provides digital engineer input to brigade orders and writes the engineer annex. He determines additional engineer capabilities needed based on brigade requirements and passes them to the division engineer. The assistant brigade engineer maintains situational understanding of organic and augmenting EAD engineer operations through brigade digital reporting procedures. The engineer battalion staff writes digital engineer orders to companies in support of task-force operations.



2 Carrier CPs
28 Carrier rises
6 M548 tracked vehicles
4 Carrier CP light
6 Volcanos
6 HEMMTs, cargo
27 HMMWVs
3 MTV truck cargo

12 ACEs
12 1-1/2T trailers
4 Water trailers
12 Wolverines
9 Javelins
4 LMTV trailers
2 3/4T trailers
12 Grizzly
5 LMTV truck cargo
12 MICLIC
12 2-1/2T trailers

Figure 3

EAD Engineer Support

Army XXI division engineers are structured to provide only minimal obstacle-creation and obstacle-reduction capabilities. Any additional engineer support needed by the Army XXI division, such as bridging and heavy construction equipment, must come from EAD engineer forces. The Engineer School is working with TRADOC as part of the Corps XXI redesign process to determine EAD engineer doctrine and organizations required to support the Army XXI division and other maneuver forces. The EAD engineer support will come mainly from the Reserve Components of the U.S. Army Reserve and Army National Guard.

EAD engineer support normally will require an engineer headquarters element (such as an engineer group) to command and control EAD engineers operating in the Army XXI division's battlespace. Some EAD engineer units may not be digitized and thus will be unable to "plug" into the Army XXI division information networks. Extensive liaison capability may be required to effectively integrate EAD engineers with the Army XXI division.

EAD engineer support to the Army XXI division is primarily in the areas of terrain visualization, supplemental obstacle-reduction capability, mobility support through restrictive terrain, emplacement of deliberate defenses, and force protection. Additionally, EAD engineers will construct, repair, and maintain combat trails, LOC facilities, routes, bases, and forward aviation support sites.

Terrain Visualization. It is the Engineer School's intent to provide digital terrain analysis and data-management capability to each BCT, the aviation brigade, and each division command post. This capability will be in the form of terrain analysis teams that use the Digital Topographic Support System. The Engineer School is working this initiative as the "Concept for the Redesign of Topographic Analysis Teams (Heavy)" through the Corps XXI redesign process with TRADOC and the Department of the Army. An article describing this concept will be published in a future issue of *Engineer.*

Obstacle Reduction. The Army XXI division engineer structure provides minimal mounted capability to reduce obstacles in support of task force attack operations. Reduction of other obstacle systems in the division area falls to supporting EAD engineer units. These units create additional lanes through obstacle systems to clear logistics base sites for occupation and open LOCs. Fixed- and float-bridging support continues to be provided by multirole bridge companies from EAD.

Restrictive Terrain Operations. The Army XXI division requires extensive EAD augmentation for operations in restrictive terrain, such as urban areas. For engineers, this includes the requirement for dismounted sappers to assist with reconnaissance and obstacle clearance in buildings. EAD engineer equipment will reduce and clear rubble along urban routes.

Deliberate Defense Operations. The Army XXI division engineer structure maintains minimal digging and dismounted sapper capabilities. These engineers have only Volcano mine systems to support limited hasty defense operations. This means that EAD engineers must provide the heavy engineer equipment (bulldozers and other earthmoving equipment such as SEEs and scrapers) needed to support a division deliberate defense. Major EAD engineer tasks in support of deliberate defense operations include the emplacement of vehicle fighting positions, dismounted infantry fighting positions, and conventional obstacles.

Force Protection. EAD engineers will provide the majority of engineer force-protection support to Army XXI division operations, including the construction of logistics-based security systems; tactical clearing of landmines and unexploded ordnance; construction of chemical decontamination sites; environmental hazard remediation; and camouflage, concealment, and deception support. The Army XXI division will conduct nonlinear and distributed operations over large areas with bypassed and other enemy forces operating at will throughout the division's battlespace. Supporting EAD engineers must secure themselves against these threats up to level II because Army XXI division security forces (military police and maneuver) will not be readily available to support the EAD engineer effort.

Construction, Repair, and Maintenance. The Army XXI division will operate over areas up to 200 kilometers wide and deep. This will require exclusive EAD engineer support to construct, repair, and maintain extended division LOC facilities, bases, routes, ports, and airfields. These missions will have a significant security risk to our soldiers and equipment because of bypassed enemy forces, irregular operations, and the lack of division maneuver and military police forces throughout most of the battlespace. EAD engineers must be able to secure themselves against higher-level threats than currently is possible and maintain continuous communications with division command posts.

Combat Service Support

The Army XXI division has consolidated CSS for armor, infantry, and engineer battalions. This support is based on situational understanding of the CSS status of each unit. For example, as an engineer company runs low on fuel, that information will be transmitted digitally to the supporting CSS unit for its response. CSS units use distributed operations and velocity management tools to provide responsive support for supply, maintenance, transportation, food service, fuel, and medical support. Army XXI division engineer line companies will receive CSS (less medical) primarily from the engineer support platoon of the BSC of the brigade forward support battalion. The engineer battalion HHC will be supported by elements of the BSC. EAD engineers operating in the Army XXI division area will continue to receive support from an appropriate EAD CSS unit, such as a corps support battalion.

General Supply, Food Service, Fuel, Water, Repair Parts, and Ammunition. When engineer operations are centrally located in the BCT area, the engineer support platoon will coordinate with the supply and transportation platoon of the BSC and send normal logistics packages out of the brigade forward support area. Most supplies will be pushed to the brigade support area or forward support area by EAD units. Then the supply and transportation platoon will move them to the engineer company.

Maintenance. All required engineer maintenance support resides in the BSC. It has a maintenance section in the engineer support platoon that includes an engineer maintenance technician, senior mechanic, and three engineer combat repair teams. Each team has improved mobility with a tracked vehicle and two wheeled vehicles and is designed to provide on-site support to a single engineer line company. Scheduled maintenance such as periodic services and maintenance problems that are beyond the capability of the combat repair teams to resolve will be provided by other elements of the BSC. The engineer support platoon may be augmented by other maintenance elements of the BSC to form a unit maintenance collection point that services all engineer vehicles from the line companies. Alternatively, engineer combat repair teams may combine with task force forward support companies to provide maintenance support. The engineer battalion HHC will be supported directly from the BSC maintenance platoon.

Medical Support. A combat medical section with 10 medics is organic to each Army XXI division engineer battalion. This organization allows for a combat medical section of three medics to be task organized with each engineer line company; doctrinal employment is one combat medic per engineer platoon. Four of the 10 medics in the engineer battalion remain on active duty, and the other six will be in the Reserve Components. Medical evacuation support will be coordinated through the task force medical platoon or forward support battalion medical company.

Training and Leader Development Impacts

Army XXI division engineers must continue to train with the combined-arms team and focus training on mobility tasks. The Army's increasing reliance on systems such as air Volcano, artillery-delivered scatterable minefields, and Raptor intelligent combat outposts require that engineers be well-versed in aviation, artillery, and intelligence functions. Increased training will be required for terrain visualization and digital engineer planning and execution using digital command and control systems. Training with Army XXI division combat service support agencies will be required to properly sustain and maintain the engineer force. The noncommand operational relationship between the division engineer staff and engineer battalions under the control of the BCTs must be fostered and developed during training. EAD engineers must be included with Army XXI division engineer training at every opportunity, such as division warfighters, combat training center rotations, and during the DCX. Many challenges will arise as we integrate Reserve Component medics and EAD engineers with Army XXI division engineer training. The Engineer School is developing new strategies to assist Army XXI engineers, including Classroom XXI distance-learning capabilities, new training simulators, and digital doctrine and training products.

Materiel Impacts

Army XXI engineers will have the same enabling digital command and control technologies as those available to the rest of the division. These include appropriate Army Battle Command System components such as the Maneuver Control System, All-Source Analysis System, and Force XXI Battle Command Brigade and Below Systems. The Digital Topographic Support System will enable the Army XXI division to properly portray terrain in these digital command and control systems. EAD engineers supporting Army XXI will require similar digital command and control components to obtain and maintain situational understanding with the Army XXI division.

Soldier Impacts

Army XXI division engineer soldiers must continue to master basic warfighting skills, which are prerequisites for gaining digital proficiency. They will require increased skills in the operation and maintenance of digital command and control equipment. Engineer soldiers will be required to maintain assigned equipment without ready access to mechanics and spare parts. They will be required to operate in isolated locations and without responsive security support. Engineer School personnel will address these challenging realities as they participate in the ongoing Corps XXI redesign process.

Conclusion

The Army Engineer School continues to stay in the forefront of all actions associated with the standup, training, and validation of the Army XXI division design. Insights gleaned from our efforts will be used to ensure that engineers remain relevant with future light-force and strike-force redesign efforts. If you have questions, call Vern Lowrey at DSN 676-4082 or commercial (573) 563-4082 or Pete Malley at DSN 676-7282 or commercial (573) 563-7282.

Major General Flowers has served as Commandant of the U.S. Army Engineer School and Commander of the U.S. Army Engineer Center and Fort Leonard Wood since July 1997.

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The Engineer Bradley Fighting Vehicle

By Major Aniello L. Tortora and Major Thomas Quigley

This article presents preliminary observations regarding the possible replacement for the M113 Armored Personnel Carrier. The Engineer School is continuing to explore materiel and doctrinal concepts related to the Engineer Bradley Fighting Vehicle. Additional information will be published as it becomes available.

To be a relevant force multiplier in the 21st century Army, combat engineers need a mobile and survivable platform from which to fight. We believe that the vehicle tentatively called the Engineer Bradley Fighting Vehicle (EBFV) is the answer. Since the mid-1980s, combat engineers have struggled to keep pace with the modernized forces they support, which are equipped with M1 Tanks, M2 Infantry Fighting Vehicles, and M3 Cavalry Fighting Vehicles. Too often, combat training center rotations demonstrate that engineer equipment is outdated and will not satisfy the demands of combat in the 1990s, nor will it meet the needs of our 21st century Army. The M113 Armored Personnel Carrier is a perfect example: It is slow, has a high deadline rate, provides little protection, and serves only as a troop and cargo carrier.

The Army is transitioning from a mechanized to an armored warfare force. In mechanized warfare, soldiers move to an objective in a vehicle and dismount to conduct their mission. In armored warfare, soldiers move on the battlefield in a survivable, firepower-laden platform that allows them to conduct their mission while mounted and under armor. The implication for combat engineers is that we need to progress from a sapper-based force to an equipment-based force. Moreover, our equipment must provide the functions needed to accomplish our mission.

The characteristics of the Force XXI battlefield will demand even more from combat engineers. Like the maneuver forces we support, combat engineers need platforms with speed, versatility, and survivability. Force XXI technologies will allow greater dispersion, enable distributed operations, and increase the tempo of battle as never before. All these Force XXI enablers put demands on providing mobility to the force unlike any previous doctrinal change. Equipping combat engineers with the Engineer Bradley Fighting Vehicle is a step in the right direction. It is essential to the future of combat engineer forces and to the success of maneuver forces.

Concept Experimentation Plan

This article discusses the initial results of an ongoing Bradley Concept Experimentation Plan conducted by the Engineer Brigade of the 4th Infantry Division and the U.S. Army Engineer School. The end state for the evaluation is twofold: to determine if the Bradley is suitable for combat engineers and to determine the advantages and disadvantages of the Bradley as a combat engineer platoon vehicle. Throughout the Bradley experimentation, the focus of the Engineer Brigade was to provide the engineer community with feedback in three areas:

- Tactics, techniques, and procedures (TTPs) for conducting combat engineer missions using Bradleys.
- The load plan, so engineers can carry what they need to execute their combat engineer missions.
- The level of gunnery proficiency engineers must achieve and how engineer training is balanced with gunnery training.

In February 1998, A Company, 588th Engineer Battalion, made history when it fielded nine M2A0 Bradley Fighting Vehicles. The Engineer Brigade received the Bradleys on loan from the 49th Armored Division, Texas National Guard, at Fort Hood.

The structure of the combat engineer company was minimally changed with the fielding of the Bradley. The number of personnel assigned to the combat engineer platoon was decreased to match force-structure authorizations in the conservative heavy division's modified table of organization and equipment (MTOE). For example, engineer platoons changed from three to two squads. Bradleys were substituted for the company's M113s. The company commander received a Bradley, and four were assigned to each line platoon—one for the platoon leader, one for the platoon sergeant, and one to each of the two sapper squads.

Two points are worth noting regarding the structure of the Bradley engineer company. First, the engineer Bradley is not called a squad vehicle. It is tentatively called an Engineer Bradley Fighting Vehicle. This name is in keeping with today's offensively oriented doctrine where the engineer platoon, not the squad, is employed as the basic breaching and reduction unit. This is also true of countermobility operations, which focus on emplacing scatterable mines. The engineer platoon sites and marks these obstacles. Second, reducing the engineer platoon from three to two squads was not precipitated by the transition to Bradleys: It is the result of a previously implemented MTOE change.

New Equipment Training

The evaluation began in March 1998 with new equipment training (NET) and culminated in August 1998 with A/588th's participation in National Training Center Rotation 98-10. The Bradley NET team from Fort Benning, Georgia, conducted the training in two phases.

- The first phase included 18 days of training on driving and licensing, maintenance, and turret operation; gunnery skills with a Unit Conduct-of-Fire Trainer (UCOFT); and Multiple Integrated Laser Engagement System (MILES) gunnery.
- The second phase was eight days of Bradley gunnery qualification training: one day of Bradley Gunnery Skills Testing and a UCOFT refresher; one day on Table V; and two days each on Tables VI, VII, and VIII.

No training was conducted on the tube-launched, optically tracked, wire-guided (TOW) missile system since it was determined this is not a weapon system engineers are expected to use to accomplish their mission. Use of the TOW launcher and the type of munitions engineers might employ in the future need further evaluation.

A Bradley vehicle transporting bundles of wire on its trim vane.

The NET was fairly easy for combat engineer soldiers and leaders, who quickly adapted to the new equipment and skills. In addition to the dedicated NET team, the company borrowed other resources to accomplish the training. A qualified Bradley master gunner was needed at both company and battalion levels to train gunnery skills and to plan, prepare, and help execute gunnery qualification. The company also required a dedicated UCOFT to prepare for gunnery training and maintain gunnery skills. For the test period, the unit acquired a master gunner from the Engineer School and a UCOFT from 2d Brigade, 4th Infantry Division.

Between phase I and phase II of the NET, A/588th conducted company/team lanes training with Task Force 1-67 Armor to prepare for the National Training Center. Representatives from the Maneuver Support Battle Lab and the Engineer School were on hand to examine the Bradley's performance. A/588th focused on validating load plans and on the TTPs for conducting missions in offensive and defensive operations. The company took this training a step further by conducting a one-week platoon lanes field training exercise (FTX) to further refine the TTPs needed to execute their mission at the National Training Center.

Preliminary CEP Results

Combat engineer soldiers embrace the Bradley because it provides them speed, mobility, protection, and firepower not possible in an M113. Engineer leaders champion this vehicle because of its versatility and potential. Maneuver forces are advocates of combat engineers in Bradleys because EBFVs can maintain the pace and tempo of maneuver forces and provide enhanced mobility and countermobility support.

Tactics, Techniques, and Procedures

The 588th Engineer Battalion is developing detailed TTPs for the Bradley Engineer Platoon and Engineer Company. Converting from M113s to Bradleys has not generated dramatic changes in TTPs. Most of the TTPs used for operations in M113s translate satisfactorily for operations in Bradleys. In some areas, however, new TTPs are being developed to support enhancements provided by the more survivable and versatile Bradley. Lane-marking and row minefield-emplacement TTPs require minor modifications. Interestingly, we found row minefield emplacement easier and more productive in the Bradley than in the M113.

Mobility

Increased speed, armor, and firepower allow combat engineers to work, maneuver, and protect themselves simultaneously. The turret and main gun of the Bradley are extremely valuable to combat engineers and increase their capability and versatility. Engineers in M113s command and control mobility and countermobility assets, but they rely on maneuver forces to protect them. This reliance often drains the already-stretched firepower of infantry and armor forces. Engineers in Bradleys can better protect themselves during movement and when breaching and reducing obstacles. Thus, the Bradley Engineer Company and Battalion are better suited to perform as a breach force during battalion and brigade deliberate breaches.

The 588th Engineer Battalion also experimented with V-type surface mine plows manufactured by Pearson Engineering. One plow was borrowed from Fort Leonard Wood and three are on loan from the Land Forces Canada. These plows have potential for maintaining mobility of the force en route to an objective. The blades can clear rubble and skim scatterable mines from level, hard-packed surfaces. They plow well in soft soil where adequate spoil can be maintained before the blade. The blade would be even more useful if it floated along its horizontal axis so it could be employed along semilevel surfaces, such as combat trails. The blade currently does not perform well on uneven surfaces or in rocky areas. More experimentation with other blades is required to fully develop this mobility asset.

Countermobility

The Engineer Bradley Fighting Vehicle increases our capability to conduct countermobility operations as well. While the EBFV platoon is capable of conducting conventional mine operations, the focus of the countermobility effort centers on the rapid emplacement of dynamic obstacles. Engineer platoon-, company-, and battalion-sized countermobility organizations can be formed with the capability to operate independently on the battlefield. If these organizations are equipped with EBFVs and scatterable mine systems, they could protect themselves during movement and while emplacing and marking obstacles.

The potential exists for adding other engineer systems to the EBFV. One possibility is to replace the TOW launcher with a weapon system that employs a high-explosive munition similar to the 165-millimeter high-explosive "bunker buster" round on the Combat Engineer Vehicle. An EBFV demolition gun could be used to reduce roadblocks and other obstacles. Another opportunity worth considering is to design and mount a small panel for Volcanos on the EBFV. Each Bradley engineer platoon would then have a rapid scatterable mine capability.

Sustainability

While not directly related to TTPs, but often having a tremendous impact on how we conduct a mission, sustainability is an area where EBFVs are winners. During a two-week company/team lanes FTX, one Bradley was deadlined. An M113 company had six M113s deadlined at various times during the same period. As we adopt the Force XXI centralized logistics support concept and move from supply-based to distribution-based maintenance, an economy of scale is created through the use of a common chassis. This makes the Bradley more sustainable in the heavy division than M113-type vehicles. Although Bradleys are more expensive to maintain than M113s, the increase in survivability, capability, and sustainability more than justifies the additional cost.

Load Plans

Soldiers from A/588th Engineer Battalion developed standard load plans for the EBFV that facilitate the successful execution of combat engineer missions. Every piece of platoon equipment was examined to determine what an engineer platoon needed in combat. TOW storage racks were removed from the M2A0 Bradley to increase interior space, and the exterior was adapted to carry wire, pickets, and tools. Although Bradleys do not have as much interior space as M113s, the EBFVs can carry the engineer equipment necessary for combat. The EBFV load plans were explored again during National Training Center Rotation 98-10.

A/588th personnel also developed plans to modify the interior and exterior of the Bradley to increase space and utility. Through an agreement with the Bradley project manager and Red River Army Depot, these plans were used to modify an M3A0 Cavalry Fighting Vehicle. Soldiers from A/588th worked with a team at Red River to complete the modifications. Bench seats with storage boxes replaced individual seats, and shelves and cabinet-type storage boxes replaced excess TOW racks and ammunition boxes. Posts were welded on the exterior of the vehicle to carry pickets and lane-marking materials, and the trim vane was used to carry concertina wire. A larger bustle rack also was installed.

These were simple and inexpensive modifications that could be completed within the battalion. M2 Bradleys can be similarly modified to increase space and function. M2 ODS Bradleys (those modified for use in Operation Desert Storm) already have more interior space than earlier M2 models as a result of similar modifications.

Gunnery

Another tremendous success story for the EBFV and combat engineers was gunnery. Confident and motivated engineers conducted Bradley gunnery only six weeks after the vehicle was introduced, and they produced astounding qualification scores. All crews qualified on their first attempt (Q1 rating), with one crew qualifying as "distinguished" and two crews qualifying as "superior." This record is rarely achieved in the division.

Engineers conducted their gunnery according to FM 23-1, *Bradley Gunnery*. A/588th soldiers practiced firing using Tables V, VI, and VII and then qualified on Table VIII. These tables should not be modified for engineers, because engineers encounter the same types of engagements while conducting their missions.

The 588th is also developing a platoon live-fire table for combat engineers. Bradley platoon gunnery for infantry soldiers consists of Table XI, *Platoon Practice*, and Table XII, *Platoon Qualification*. Qualification is based on the platoon's ability to execute collective tasks in a live-fire environment. Similarly, the engineer platoon Table XII focuses on offensive and breaching operations under live-fire conditions. A Bradley engineer Table XII serves as an excellent graduation exercise from platoon lane training and also prepares the engineer company to participate in the maneuver task force Combined Arms Live-Fire Exercise.

Enhancing the Combined Arms Team

The EBFV has made engineers a more valuable part of the combined arms team. It is the platform from which to launch combat engineers into the Army After Next. Inexpensive and simple modifications to the Bradley have alleviated load-plan fears. Plows and other attachments offer advantages for the combined arms team and will enable the engineer force to move from the mechanized to the armored way of warfare. The Bradley provides a more survivable platform for our soldiers. In our experience, gunnery was not a distracter to training. We believe it has potential to improve engineer training by merging gunnery with engineer lane training.

For current Engineer Bradley Fighting Vehicle information and photos, visit the Engineer Brigade, 4th Infantry Division (Mechanized), web site at *http://hood-ivygreen.army.mil/engineer*. Send comments and input to the brigade S3 e-mail address provided on the web site or directly to *tortoran@hood-emh3.army.mil*.

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Book Review

On Killing: The Psychological Cost of Learning to Kill in War and Society, by Lieutenant Colonel David Grossman, Little, Brown & Company Limited (Canada), 1995, 366 pages. The ISBN is 0-316-33000-0 for a hard cover and 0-316-33011-6 for a paperback.

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In his book *On Killing: The Psychological Cost of Learning to Kill in War and Society,* Lieutenant Colonel David Grossman offers a fascinating and perceptive insight into the mental anguish and emotional impact of violence. Grossman's study is somewhat unique in that he does not try to explain what makes soldiers kill, but rather how they are able to overcome an inherent resistance to killing fellow men. This book is a compelling work for anyone in the military or law enforcement, especially those responsible for training soldiers to kill the enemy.

S.L.A Marshall's famous work, *Men Against Fire,* documented astonishingly low firing rates for American riflemen during World War II. According to Marshall, only 15 to 20 percent of U.S. combatants in World War II fired their weapons at the enemy. Grossman points out that this reluctance to kill is not unique to World War II, and he provides psychological and sociological reasons for soldiers' actions and reactions in combat. He cites situations throughout history when "warriors" have apparently refused to kill, even when faced with mortal danger.

According to Grossman, "Since World War II, a new era has quietly dawned in modern warfare: an era of psychological warfare—psychological warfare conducted not upon the enemy, but upon one's own troops." When S.L.A Marshall went to the Korean War to conduct the same type of investigation as he had in World War II, he found that 55 percent of the infantrymen were firing their weapons. In some units, almost 100 percent were firing! The question was, What made the difference in the soldiers' attitudes?

Desensitization to killing is the first element to the improved firing rate. Thinking of enemies as "inhuman" or calling them by disparaging names, such as gooks, Krauts, Japs, or Commies, seemingly is innocuous behavior, but that behavior helps a 19 year old overcome his natural aversion to killing.

Conditioning soldiers is another element. Both Pavlovian classical conditioning and Skinnerian operant conditioning have roles in training soldiers to kill without thinking about it. Grossman does not claim that the armed forces intentionally condition their soldiers to kill, but he provides examples of its existence. One example is modern firing ranges, where every aspect of killing is rehearsed and visualized. These actions provide soldiers with realistic and interesting stimuli. When the soldiers do well, they are regularly rewarded and praised by superiors and peers.

Thorough training also provides a denial defense mechanism for dealing with the extreme trauma of killing. Soldiers have practiced killing so much that when they actually do, it's no big deal, it's almost like being on the range. There are several documented examples of soldiers talking about killing as being like shooting E-type silhouettes on the rifle range. This denial allows soldiers to psychologically deal with the act of killing.

Grossman diagrams what he calls the "Anatomy of Killing." The significant elements in this theory include the demand of authority, group absolution, total distance from the victim (both physical distance and emotional distance), target attractiveness of the victim, and the predisposition of the killer. According to the author, only 2 percent of our population can kill without any real feeling of remorse. Of this group, only a few are able to effectively function in a regulated, military environment. The rest of the population (98 percent) face extreme difficulty in overcoming the natural abhorrence to violence and dealing with the traumatic aftermath of killing. The elements in Grossman's model dynamically interact with one another as a soldier decides whether or not to squeeze the trigger.

Grossman includes lengthy discussions of post-traumatic stress syndrome in Vietnam veterans. His analysis provides reasons for the seemingly disproportionate number of Vietnam veterans suffering from mental illness and substance abuse. As a society, we must understand the consequences of sending soldiers to war, what they endure on the battlefield, and how to accept them back into society.

The author concludes with a look at American society and how popular culture is "desensitizing" America's youth. Grossman claims that some of the same conditioning techniques that allow soldiers to kill on the battlefield are partly responsible for kids killing each other in the streets. The author ends with dire warnings about the future and somewhat radical solutions to the dangers of violence in movies, music, and television.

LTC Grossman is able to take a scientific work and make it readable, interesting, and easily understandable. He uses historical anecdotes and personal accounts from hundreds of interviews to give the book a personal and authentic feel. *On Killing* does not in any way come across as a sterile, clinical analysis of soldiers' psyches. It is a compelling analysis of what is required to turn a normal 19-year-old American into a soldier, capable of killing or maiming his fellow man, and return him to a productive life in society. This book is a must-read for anyone responsible for training, leading, and commanding combat soldiers.

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OPERATION DESERT THUNDER:

COALITION TASK FORCE-KUWAIT ENGINEER OPERATIONS

By Lieutenant Colonel William Bowers, Major Michael Lynch, and Major Donald Johantges

> *"Saddam must have realized from past experience that moving his troops against Kuwait's border would be a fruitless exercise, so he didn't bother. He seemed to have learned from 1994 and 1996 that the United States would win any 'race for Kuwait.' This time, he merely dispersed his armored and mechanized forces throughout Iraq to protect them from air attacks. It was at this point that American ground forces began to arrive in Kuwait. Saddam Hussein probably wondered at the purpose of this deployment of land power, for he was not directly threatening Kuwait with his ground forces. We can't know for sure what conclusions he drew from this development, but shortly after Third Infantry Division and First Marine Expeditionary Force units began taking up residence in Kuwait, he struck a deal with U.N. Secretary General Kofi Annan. The crisis was over."*
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> *Third Army Staff Member*

A series of Iraqi provocations against Kuwait in November 1997 resulted in a crisis that lasted until March 1998. Defending Kuwait was the responsibility of Coalition Task Force-Kuwait (CTF-K), commanded by the U.S. Army Central (USARCENT) Commander. CTF-K consisted of units from all service components as well as representatives from 10 other countries. The United States responded also to help deter Iraqi aggression and reassure the coalition partners—or defend Kuwait should that become necessary. More than 11,000 U.S. personnel and 35,000 coalition personnel participated in this operation, which came to be known as Desert Thunder.

Engineer Mission

The USARCENT Assistant Chief of Staff, Engineers was the C7 of CTF-K. He and his staff simultaneously deployed forces; provided facility support for reception, staging, onward movement, and integration; supervised engineer operations and planning; and supported intelligence planning with topographic supplies.

The CTF-K C7 engineer mission was to establish and manage the commander's engineer policies and guidance. This included staff supervision of combat, combat support, and combat service support activities. Construction contracting assets and other activities in the areas of combat, civil, electrical, and topographic engineering; force protection; and real estate planning also required intense management.

Deployment

The deployment process began with an analysis to determine engineer requirements to ensure mission success. Since this was a short-notice deployment, a crisis action planning cycle was used. With only a few days to plan, the foundation was initially based on doctrinal allocations. The analysis began by examining the forces allocated for the operation. The CTF-K engineer did not use the time-consuming Joint Engineer Planning and Execution System (JEPES) because of the short planning period. During deliberate planning the JEPES model is used to help ensure that all engineer requirements are identified.

The staff, which was still in Atlanta, developed the units' construction needs based on requirements for previous deployments. Then staff personnel contacted Corps of Engineers assets in Kuwait to determine which of those construction projects the Corps would perform. This modification to the deployment plan met the commanding general's guidance of "just enough, just in time." Several unknown factors—such as the availability of host-nation facilities and equipment, presidential selective reserve call-up, and support from other coalition countries—were critical and estimates were factored in for them.

After the CTF-K engineer section identified its requirements to support the operation, it was the services' responsibility to provide resources. A daily dialogue developed between CTF-K and the services' engineer action officers so we could monitor the engineer force flow.

Sequencing the arrival of engineer units in country and balancing those arrivals against available host-nation support was a challenge. Combat engineer units had to move with their respective maneuver elements. Fire-fighting units arrived in conjunction with aviation elements. Topographic engineers were integrated in the flow to support the headquarters elements and components. Division headquarters controlled divisional assets of the combat and topographic engineers, while echelon-above-division assets—such as fire-fighting teams, corps topographic engineers, personnel from the prime-power detachment, and the 416th Engineer Command—required detailed coordination daily between the CTF-K engineer and force providers.

After arriving in country, the engineer assessment team realized that engineer support to bed down the force would be the most critical "do not fail" task. Recognizing the extent of this challenge, the CTF-K engineer adjusted the staff deployment flow. He brought in facilities and construction staff support early to provide engineer contracting expertise and other technical skills.

Facilities Support

A modern headquarters requires an immense amount of electrical power. All CTF-K staff sections use both secure and unsecure computers, telephones, and facsimile machines extensively, as well as a coffeepot, refrigerator, and microwave oven. The high demand for electrical power in fixed facilities makes an electrical engineer an invaluable member of the staff. To meet that demand, the CTF-K coordinated to deploy power-distribution experts from the 249th Engineer Battalion (Prime Power). Together, they successfully managed electrical problems within Camp Doha, which was established after Desert Storm as a long-term USARCENT camp, and identified potential problems at other facilities. Military engineer expertise is especially important when deploying to areas with different cultures. Because of many religious holidays, host-nation contract personnel may not be available to take care of daily problems.

Engineer Operations

Over the next two weeks, the engineer section grew to 11 personnel, with USARCENT providing the core of engineer staffing. Personnel from CENTCOM's Joint Crisis Action Center and the 416th Engineer Command (Forward) completed the staff.

Sufficient facilities and construction staff personnel did not deploy early enough in the flow as the CTF-K headquarters was established. This placed a heavy burden on the limited staff in the CTF-K engineers' facilities and construction division. As large numbers of personnel surged into and through Camp Doha, the number of infrastructure breakdowns increased significantly—particularly in electrical power and sewage disposal.

Combat units transitioned quickly through Camp Doha and then moved directly into occupied base camps or kabals in the Kuwaiti desert. A kabal is enclosed by earthen berms

A joint bed-down facility in northern Kuwait.

The kabal's shower point is upgraded by using shower trailers that provide climate control and heated water.

that establish the perimeter for force protection. In Operation Desert Thunder, most kabals were large enough to accommodate a battalion-sized task force. The task force kabal is a self-contained support area with living tents, mess facilities, motor pools, and recreation facilities. The commercially leased tents were equipped with wood floors, field showers, and burnout latrines. A commercial generator connected to a power grid provided electrical power for the area.

The Kuwaiti government and people were eager to assist the coalition force with facilities and construction support. Numerous construction contractors were available, which took some of the construction burden from deployed engineers. In addition, the Kuwaiti government gave U.S. forces access to several military facilities, thereby eliminating the immediate need for leasing real estate and using expensive transportation assets for supplies and equipment.

Occupying host-nation installations greatly reduced the scope of engineer construction. Use of these facilities throughout Kuwait City was coordinated through the U.S. Embassy, Office of Military Cooperation-Kuwait. The CTF-K engineer staff assessed many unused facilities in the city to determine the repairs necessary to make them functional as billets, office space, dining facilities, recreation areas, etc. Required repairs typically involved water, sewer, or power upgrades. If a facility was deemed inadequate, the engineer section wrote a scope of work to bring it up to standards outlined in the Civil Engineering Support Plan for Operation Desert Thunder. Upgrading wooden field showers in the kabals to trailers with electric water heaters and air conditioning is an example. In most cases, work was contracted through host-nation construction firms or performed by host-nation contract engineer assets.

Each facility was also evaluated using the U.S. Central Command (USCENTCOM) force protection construction standards, which outline the type of construction and standoff distances. This evaluation helps ensure that U.S. personnel are not exposed to unnecessary risks due to catastrophic structural failure caused by weapon systems or truck bombs.

Intelligence Planning

Intelligence preparation of the battlefield (IPB) was another key task in Kuwait. Topographic products to support CTF-K operations were in high demand throughout the deployment, especially early in the IPB process. The CTF-K staff included a topographic manager from the 132nd Engineer Battalion, who worked with the terrain teams. In addition, the 100th Engineer Company (Topographic) organized and deployed a 10-person team to support the CTF-K. The terrain team established joint operations with the National Imagery Mapping Agency team and elements from the supporting military intelligence brigade to allow use of intelligence communications systems with bandwidth capability to obtain real-time imagery. Together these teams provided automated and conventional terrain-analysis support with equipment that included multispectral image processors, large-format plotters, tangent scanners, and a database of the joint operational area.

Environmental Management

Environmental management, an important area early in any deployment, was overseen by a civilian contractor from USARCENT. The Overseas Environmental Baseline Guidance Document specifies standards we must maintain during contingency operations. The CTF-K environmental officer established procedures for hazardous- and solid-waste collection and disposal, spill prevention, and cleanup. As units arrived, the environmental officer briefed commanders on the procedures.

USARCENT environmental specialists inspected the training areas periodically. Typical deficiencies noted during these inspections were unchecked petroleum, oil, and lubricant releases; improper solid-waste disposal; improper secondary containment; and a lack of hazardous-materials training and waste-management training. Units must conduct proper environmental operations when training overseas, just as they do when training in the United States.

Soldiers of the 317th and 11th Engineers construct berms to improve force protection.

Forming the Coalition

After force bed down and the IPB process were well underway, forming the coalition became the CTF-K staff's top priority. Participating coalition countries represented the entire world, and each had unique tactics, techniques, and procedures. Only a few foreign representatives had any knowledge of U.S. engineer doctrine. Without standard procedures for obstacles—especially mines—there is always a potential for fratricide. To help mitigate that risk, the CTF-K engineer staff produced a minefield data booklet in both English and Arabic. The booklet contained standard diagrams to mark coalition minefields and lanes through those minefields, as well as information on engineer obstacle-effects graphics.

CTF-K engineers sponsored and participated in a series of meetings with coalition partners to improve their understanding of U.S. Army engineer doctrine, capabilities, and limitations. Most importantly, the CTF-K C7 sent an engineer liaison officer to the Kuwaiti Engineer Brigade. This officer helped close the doctrinal gap and reduce friction associated with intercultural communications.

Lessons Learned

Several important lessons resulted from our experience in Kuwait:

- Dedicate one officer to develop and manage the Time-Phased Force Deployment Data when preparing for deployment. That officer must maintain daily contact with planners for the Joint Operations Planning Execution System and the force provider. (In our case, the force provider was FORSCOM.)
- Ensure that the engineer staff is multifunctional. To support contingency operations, the section must include combat, facilities, construction, and environmental engineers. Facilities and construction engineers must deploy early and possess electrical engineering expertise to handle the bed down of the initial surge of forces.
- Use available adequate host-nation structures. To speed contracting for facilities that do not meet our standards, prepare generic construction statements for repetitive requirements.
- Use contract construction as much as possible to reduce the number of deployed engineer troops and promote the philosophy of "just enough, just in time."

Conclusion

The CTF-K is an organization unique in our nation's military history. Never before have we formed a forward-deployed, joint, multinational, ground-combat-oriented, and rapidly expandable deterrent force. CTF-K proved its worth during Operation Desert Thunder by contributing to a show of force that ultimately succeeded in deterring Iraqi aggression and compelling compliance with U.N. mandates. As long as it continues to stand, CTF-K will fulfill this role. This unique organization allows the United States to achieve unprecedented levels of interoperability with foreign militaries in a region that is of vital importance to our national security.

Lieutenant Colonel Bowers was chief of the Engineer Plans and Operations Division for CTF-K from February to April 1998.

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Tactical DPW in Bosnia-Herzegovina

By Captain David G. Winget

On permanent military bases, a Directorate of Public Works (DPW) controls construction projects. The DPW structure—consisting of a military director with mostly civilian engineers—was designed to provide construction support to one base in a secure environment. In a potentially hostile environment such as Bosnia-Herzegovina, the DPW organization is not practical. There, several base camps—ranging from a platoon-sized element on a hilltop to a division headquarters housing more than 2,000 people—are spread over 100 miles. A new structure was required to support the diverse multinational force.

The American sector of Bosnia, Multinational Division-North, includes elements from the 1st Armored Division, the 2nd Armored Cavalry Regiment, the 401st Expeditionary Air Base Group, a Nordic/Polish Brigade, a Russian Brigade, and a Turkish Brigade. American units form Task Force Eagle, which is spread over 13 main base camps and five hilltops in support of the NATO peacekeeping mission. Because this situation made the usual DPW structure impractical, the Base Camp Coordinating Agency (BCCA) was created in January 1996. Staffed mostly by armed military engineers with up-armored HMMWVs, the BCCA became a tactical DPW responsible for all base camp facilities and occupied hilltops in the American sector.

The BCCA's scope and responsibilities are similar to those of a DPW, but they are modified for use in a deployed environment. The agency supports Operation Joint Guard by providing facility engineer planning and operations, project management, and Joint Acquisition Review Board administration. The BCCA also assists with development and maintenance of base camp standards, base camp assessments, environmental engineering, ammunition surveillance, real estate acquisition, fire inspection and prevention, and financial oversight of the operation's sustainment contract. Located in Tuzla Main, the BCCA staff normally ranges from 11 to 14 personnel. The agency reached a peak of 24 personnel in September 1996 to facilitate base camp decommissioning and closure when the Implementation Force of 20,000 downsized to the Stabilization Force of 8,500. The BCCA currently is staffed by seven active duty military personnel on temporary change-of-station orders and four civilians.

Organization

The BCCA chief, a lieutenant colonel, serves as a special staff officer on the Task Force Eagle staff. He is Task Force Eagle's single point of contact for all base camp facilities, which are managed by six organic and three nonorganic sections within the BCCA.

Plans Section

This section develops plans and orders for future operations, forecasts necessary construction support for these operations, and coordinates with Task Force Eagle staff. Identifying issues, collecting information, and developing courses of action are integral parts of the planning process. When the Operation Joint Guard mission was extended, a process action team was formed to set new standards for construction. The team expects to increase the level of force protection and the standard of living. By proposing and analyzing several courses of action, the team can develop economical solutions to meet future needs in a less temporary environment. The plans section recently acquired AutoCAD software, which allows it to develop standard designs for projects such as medical aid station bunkers, barracks-style living containers, and chapels. In addition, the section helps each base camp develop a master plan for site layout that will meet future needs with an organized and economical solution.

Multinational Division-North soldiers construct a 100-man bunker.

Operations Section

This section conducts day-to-day operations for the BCCA and collects detailed information on base camp population, capacities, life-support capabilities, and other key factors affecting the success of Task Force Eagle. The section also develops and maintains the *Base Camp Standards*, a document that governs base camp facilities and services and defines the minimum construction standards authorized within the limits of good fiscal stewardship. This document is continually updated to conform to current conditions, military needs, and available resources, based on the changing mission of Operation Joint Guard.

Project Management Section

Construction projects are processed through this section, which validates the need for new work through interaction with the customer. Section personnel determine the scope of work needed and ensure that the work complies with *Base Camp Standards*. The section also provides technical construction expertise and identifies economical ways to meet requirements. After determining requirements, section personnel pass specifications and drawings to contracting officers or military engineers for execution. They also track projects on a theater-wide database and hold weekly in-progress reviews with the contractor to update statuses and identify potential problems.

Base Camp Assessment Team (BCAT)

The BCAT inspects each base camp and occupied hilltop monthly to ensure that occupants comply with standards. Traveling in a convoy of four up-armored HMMWVs, the team focuses its inspections on force protection, environmental compliance, safety, fire prevention, and ammunition storage. After completing an inspection, the BCAT conducts an outbriefing with the base camp mayor and tactical commanders. The team provides guidance and assistance to unit representatives in each area inspected.

Environmental Section

This section provides technical oversight of Task Force Eagle operations to ensure that U.S. personnel conduct operations in a manner that protects human health, complies with appropriate environmental regulations, and is consistent with responsible environmental stewardship. A Corps of Engineers civilian environmental specialist provides guidance on hazardous materials and hazardous waste management, pollution prevention, and waste minimization. He also oversees environmental baseline and closure studies and periodic sampling of Task Force Eagle sites. For new construction, the environmental specialist identifies environmental concerns and develops courses of action to address those concerns.

Contingency Real Estate Support Team (CREST)

These civilian members of the Corps of Engineers secure leases for land to support operational requirements and work with landowners to address their concerns. Team members write leases, investigate property titles, and assess damages to help settle claims.

Nonorganic Sections

Nonorganic sections that work closely with the BCCA include a prime power platoon, a military fire-fighting platoon, and a quality-assurance specialist, ammunition surveillance (QASAS) representative. The prime power unit operates the tactical power plant for Tuzla Main and provides liaisons to the BCCA to assist with electrical projects. Firefighters participate in BCAT inspections, develop the firefighting plan for Task Force Eagle, and provide expertise in fire-protection standards for contingency projects. The QASAS representative serves on BCATs and helps plan ammunition holding areas.

Construction Projects

The BCCA divides construction work assignments into three categories: troop labor; Brown & Root Services Corporation, which holds the sustainment contract for Operation Joint Guard; and local contractors. Military construction assets located in Multinational Division-North include elements from a mechanized combat engineer battalion and an attached Navy Seabee company. The engineer battalion reviews all approved construction requests before the BCCA gives them to a contractor to determine if it has the assets required for the job. If the engineer battalion does not, projects are given to Brown & Root. The BCCA occasionally deals directly with local contractors.

Construction projects originate with work requests from units, base camp mayors, or division staff members. The project management section validates the requests, assigns a priority to them, and forwards them to military engineers or the Defense Contracting Management Command for execution by Brown & Root. Projects costing less than $2,500 are executed immediately under the authority of the BCCA chief. For those costing more than $2,500, a Rough Order of Magnitude is prepared and sent to the Joint Acquisition Review Board for consideration. The board recommends approval or disapproval to the division chief of staff, who holds approval authority for projects costing up to $50,000. Projects exceeding $50,000 are approved by the United States Army-Europe.

Foreign nation support is another type of construction request. Foreign units in the American sector sometimes must rely on Brown & Root for construction support. As long as Americans do not benefit from the project, this type of request requires no approval and is paid for by the foreign nation. After a Rough Order of Magnitude is prepared, a representative from the nation signs an agreement to reimburse the United States for expenses.

The BCCA handles a variety of projects, such as force-protection upgrades, quality-of-life improvements, and mission support. Base camp design is focused on force protection to withstand terrorist attacks as well as provide a safe working environment for soldiers. Several projects involve hardening structures with a force-protection wall of bastions and constructing bunkers, crash-resistant gates, and fighting positions. The average tour of duty in Bosnia ranges from 6 to 12 months, so quality-of-life improvements are critical to maintaining morale. Current quality-of-life projects include upgrading 48 living tents to wooden seahuts (512-square-foot, plywood, one-room structures with electrical outlets and a heating, ventilation, and air-conditioning unit); constructing a morale, welfare, and recreation tent for soldiers; and upgrading gyms and TV/game rooms. Mission support includes a wide range of construction projects—from a railhead loading site to a life-support area for a gunnery range.

Construction Challenges

Political, military, and environmental conditions in Bosnia-Herzegovina cause several engineering challenges. Therefore, the BCCA must constantly re-evaluate and improve construction designs to ensure they are compatible with the ever-changing environment. As with all engineering projects, the overriding factor is cost, and the goal is to achieve the best solution for the lowest price.

Temporary Construction

Army engineers must restore land to its original state after closing a base camp, so a major engineering challenge for the BCCA is that all construction must be temporary. As a result, concrete is used only occasionally in prefabricated slabs or barriers. Gravel over geotex is often substituted for concrete because it is easily removed. Most structures also are temporary and are easily removed—such as tents, wooden seahuts, or containerized units—but a few are pre-existing permanent facilities. When a base camp closes, construction materials are reharvested for future projects. An environmental survey is then conducted and compared to the baseline survey conducted before occupation, while the CREST team gathers photographs to assist in settling damage claims with landowners.

Winterization

Due to the extremely cold winters in Bosnia-Herzegovina, winterization techniques are incorporated in construction projects. For guard towers, a sliding plexiglass window that can be closed to contain heat or opened during emergencies is installed on each wall. Three coats of paint are applied to wooden structures to protect them from rain, snow, and ice. Tents are upgraded to tier three standards, which include plywood floors and walls, roof trusses to support snow loads, electrical outlets, and lights. They are heated with two kerosene heaters. Tents that are not occupied for a few days—and therefore not heated—often require repairs due to heavy snow loads that accumulate on roof trusses.

Ground Conditions

A high water table and poor soil conditions in Bosnia also present challenges. Sand for sandbags and soil for fill material must be purchased and transported to construction sites. Perhaps the largest cost associated with most construction projects is the enormous amounts of gravel used to stabilize soil. Bunkers and fighting positions must be constructed aboveground, and all structures must have large footings on a thick foundation of gravel.

Utility Costs

Since Operation Joint Guard has been extended, the BCCA is seeking ways to reduce utility costs. One method under consideration is to convert from generator to commercial power where feasible and use generators for backup power in critical areas. Another option is to convert to well water rather than use bottled potable water and nonpotable water delivered by Brown & Root. The BCCA is investigating the feasibility of digging test wells at some base camps. For force-protection reasons, however, a water source outside the base camp is not practical. To save heating costs while upgrading soldiers' quality of life, the BCCA may discontinue using tier three tents and use seahuts or containerized living units, which are electrically heated. Finally, mobile generator-powered sets on base camp perimeters are being replaced with fixed poles with lights that operate from commercial power or a central generator.

Coordination

When a project is assigned to both Brown & Root and military engineers, the BCCA must ensure that they coordinate etween construction phases through reconstruction conferences and in-rogress reviews. Details are worked out ith a representative from the engineer attalion and a Brown & Root liaison, nd any conflicts are resolved. For examle, approximately one million landines and various unexploded ordances remain in Bosnia-Herzegovina om the war. New construction sites that ave not been cleared of mines require urface clearance. Before Brown & Root an start a new project in an uncleared rea, they must coordinate through the CCA to have military engineers clear ie ground.

Conclusion

The BCCA is a nondoctrinal organization that has served and continues to serve its purpose in upport of Operation Joint Guard. The gency continues to assess the evolving ission and to plan for future requireents, while providing construction upport and base camp assessments to ask Force Eagle. Faced with many hallenges in construction design and hanges in standards, the agency mainins flexibility and continually seeks to rovide the best possible product at the west cost. It accomplishes this goal by aintaining a close working relationship vith Brown & Root, the Defense Conracting Management Command, miliry engineers, base camp mayors, and e tactical commanders. The BCCA rganization provides a template that can e used for base camp management durng future multinational stability and upport operations.

Captain Winget is attending the ngineer Officer Advanced Course. He vas assigned to the 20th Engineer Batalion, 1st Cavalry Division, and was n temporary orders to support the 1st rmored Division as Project Manager or the BCCA during Operation Joint Guard. From February to June 1997, he upported Operation Intrinsic Action in uwait. CPT Winget is a graduate of he United States Military Academy.

Lessons Learned

The following lessons learned during Operation Joint Guard may assist units deploying to support other stability operations:

Sustain

☐ Ensure that troop engineer units, the contractor, and the BCCA coordinate daily to resolve problems and develop better solutions.

☐ Allow troop engineers first choice of every project to reduce costs and sustain unit training.

☐ Colocate the troop engineer construction management section and the BCCA in the same building to facilitate information flow and shared assets and equipment.

☐ Staff the BCCA with officers holding a degree in engineering and who understand tactical operations.

☐ Develop a thorough and regular base camp inspection program to maintain high levels of safety, force protection, environmental standards, ammunition safety, and fire prevention.

☐ Establish a mayor (who is not occupied with command responsibility) to be the single point of contact for each base camp. That individual will assist in communication with customer units and resolve issues between units at each camp.

☐ Obtain support from the Corps of Engineers for equipment, personnel (real estate and environmental specialists), and other expertise.

☐ Ensure that the BCCA works directly for the senior commander on the ground, not for a higher headquarters, to ensure that construction supports the commander's intent.

Improve

☐ Provide additional personnel so the BCCA can expand its responsibilities and provide a better product at a lower price. For example, provide engineers to perform independent government estimates on projects and clerical and administrative personnel to assist in day-to-day operations so engineers can focus on construction.

☐ Create a BCCA structure as early as possible in the deployment to manage initial base-camp construction and develop a plan for overall base-camp layouts. Base camps built without detailed plans often must be relocated at additional expense.

☐ Develop a flexible master plan for base-camp layout that allows for expansion.

☐ Determine the initial standards of living and level of force protection—in as much detail as possible—and establish a board to review these standards quarterly to consider changes in funding and mission requirements.

☐ Organize personnel into two teams—with all personnel in each team from the same unit if possible—and replace only one team at a time to maintain continuity.

☐ Plan for a minimum overlap of two weeks between outgoing and replacement personnel.

☐ Delegate approval authority for projects costing less than $100,000 to the highest commander on the ground, because he has a better picture of the situation than higher headquarters. This method allows for quick approval of high-priority projects.

☐ Ensure that all military engineers in a joint operation (Army, Navy, Air Force, and Marines) work together under one engineer commander for facilities construction. This alignment facilitates a coordinated engineer effort, maximizes efficient use of assets, and prevents differing standards of living for military personnel.

Underground Combat:

Stereophonic Blasting, Tunnel Rats, and the Soviet-Afghan War

By Lester W. Grau and Ali Ahmad Jalali

The U.S. Army fought subterranean battles in the tunnels of Vietnam. Following a few tear-gas grenades or a charge of C4 plastic explosive, "tunnel rats" would go underground to find Viet Cong or North Vietnamese combatants or materiel. Small, slender soldiers armed with flashlights and.45-caliber pistols would crawl into the Vietnamese tunnels for reconnaissance and possible close combat. Almost all of the Vietnam-era tunnel rats have left active duty now, but the need to train for this type of underground combat remains. The U.S. Army's experience with tunnels was not unique. From 1979 to 1989, the Soviet 40th Army waged war against the mujahideen in Afghanistan. Part of this war was fought in the tunnels of Afghanistan, which were larger and far more extensive than those in South Vietnam.

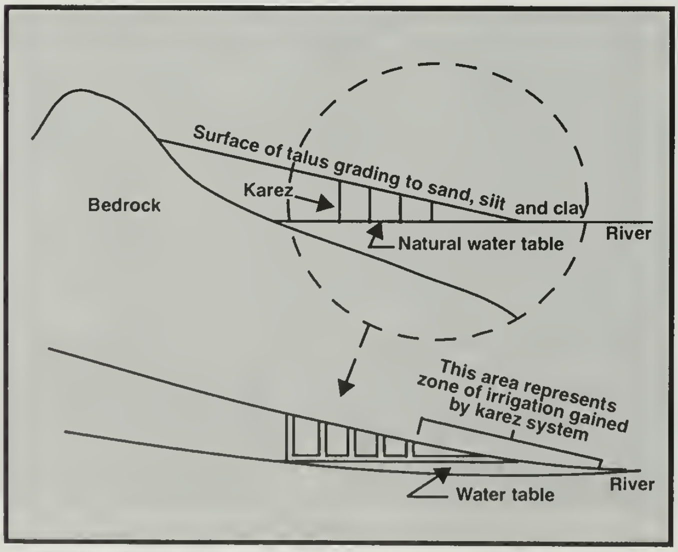
Bedrock
Surface of talus grading to sand, silt and clay
Karez
Natural water table
River
This area represents zone of irrigation gained by karez system
Water table
River

Figure 1. Idealized cross section of a karez system.

Welcome to the Underground

In the Middle East, water is life itself. Over the centuries, the inhabitants of Iran, Afghanistan, and Western Pakistan have taken some extraordinary measures to preserve and conserve this precious resource. Since many of the rivers are seasonal, rural inhabitants have found ways to prolong their agricultural water supply during the dry months. Open-ditch irrigation is used in the northern part of Afghanistan, where the water table is relatively shallow, but in eastern, southern, and southwestern parts of the country the extensive underground *karez* system (a man-made water system) is necessary.[1] When flying over these regions, the neat lines of mounds that lead from the foothills across the desert to the "green zones" of vegetation surrounding towns and villages are a common sight. The mounds are entrances to shafts that intersect the water table and that are connected to each other by tunnels (Figure 1). The deepest shaft highest

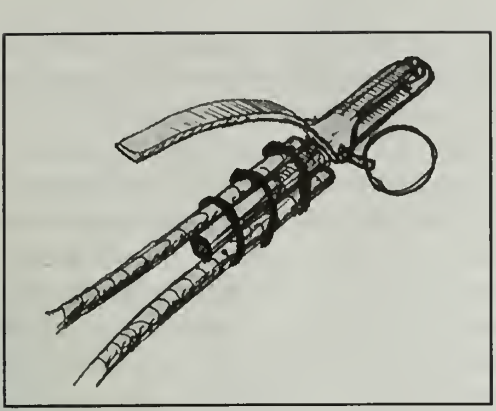

Figure 2

on a hillside intersects the water table. Water moves through he tunnels and into irrigation ditches and fields near the owns and villages.[2] Some of the karez tunnels stretch for several kilometers underground. Some historians claim that he karez system was already working when Alexander the Great went through Afghanistan in 328 B.C.[3]

The karez tunnels are dug by farmers. Occasionally they use large ceramic tile drainpipes to shore up weak sections of the strata. Digging the tunnels is dangerous work because the shafts usually range from 9 to 15 meters deep, with some more than 30 meters deep. The tunnels are labor- and maintenance-intensive. Silt that collects in them must be cleaned out annually and hauled to the surface by a windlass equipped with goatskin bags.[4]

The karez tunnels also have another use. Since ancient times, villagers have used these underground waterways for shelter against invading armies. Chroniclers of Afghan history in medieval times refer to the use of the karez by civilians and combatants during the invasion of Genghis Khan's Mongol armies in 1221 A.D. The Mongols set out to destroy all major cities in Afghanistan and neighboring areas and made every effort to massacre the inhabitants to the last man.[5] The Mongols did not go into tunnels after the refugees. Rather, a day or two after destroying a town, the Mongols sent a small detachment back to the area to cut down any resurfaced survivors. They did this to ensure that no potential resistance against Mongol rule remained. The Mongols had learned during earlier campaigns that the official surrender of a city did not guarantee permanent submission of the area, because the inhabitants often rose against the invader after his main force moved on.

During the Soviet occupation, both villagers and local mujahideen guerrillas used the karez system as a hiding place. Since the towns and villages are close to the karez, they provide ready-made shelters from bombing and artillery attacks. Guerillas dug caves in the sides of the shafts, where they hid weapons and themselves, and used the karez tunnel network to move undetected to and from ambush sites and attack positions. According to mujahideen eyewitness accounts, Soviet forces passing through an area usually did not try to flush out the refugees and guerrillas hiding in tunnels. However, in major cordon-and-search actions, the Soviets and Afghan communist forces made special attempts to destroy the underground mujahideen.[6]

Underground Warfare 101

In the mid-1980s, the Soviets conducted a tunnel-neutralization course in Paghman Province, about 14 kilometers northwest of the capital city of Kabul. The course was designed for Afghan special-forces soldiers and was similar to courses provided for Soviet sappers in Afghanistan. The training was necessary because men do not readily go underground to fight. Tunnels are ideal locations for booby traps, knives thrust from a side tunnel, and cave-ins.[7] Additionally, tunnels teem with snakes, scorpions, and other creatures.[8] After a short course in theory, participants in the tunnel-neutralization course moved to the field for practical applications.

The soldiers conducted a reconnaissance to find shaft entries, which usually were marked by mounds. The Soviets taught the soldiers to form into two covering groups and hold two adjacent shafts simultaneously. Since civilians often hid in the karez, the first step was to yell into the shaft and demand that anyone sheltering inside come out.[9] The soldiers were taught to yell without exposing themselves to answering gunshots from inside the karez. If no one answered or came out, the next step was to throw two RGD-5 concussion grenades in the karez.[10] After the grenades exploded, it was customary to again demand that the occupants surrender because the karez was about to be blown up.[11]

The depth of a shaft was determined from the sound of a falling rock tossed inside. After determining the depth, soldiers used a mirror to reflect sunlight down into the shaft and examine it. If there were areas they could not examine, the soldiers tied a cord to a grenade, lowered the grenade to the suspect area, and detonated it. Only then would soldiers lower a blasting charge on detonating cord. They usually used captured TC-2.5 or TC-6.1 Italian antitank blast mines because many of them were available.[12] The soldiers then lowered the first charge to the bottom of the shaft. Next they prepared a second charge using three or four meters of detonating cord and 800 grams (two and three-quarters pounds) of high explosive. Then they tied or taped the detonation cord to a standard hand-grenade fuze (Figure 2). They would weight the firing assembly with a rock or wedge it near the mouth of the shaft. Two trained soldiers could prepare a 20-meter shaft for detonation in about three minutes. All that remained was to pull the ring on the firing assembly. After four seconds, the charges would explode. During the explosion, it was necessary to stand at least five or six meters from the mouth of the shaft, because the explosion caused rocks to fly from the shaft like a volcano.[13]

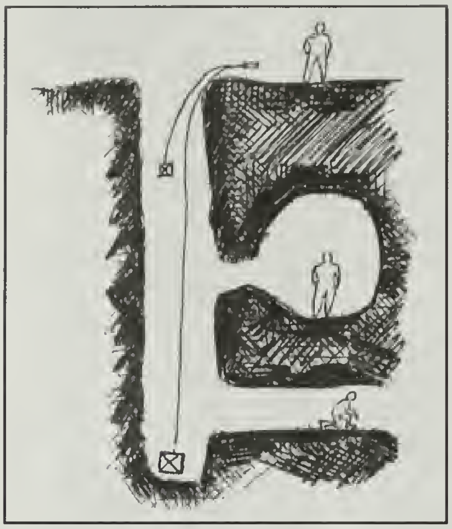

Figure 3

The Soviets' placement of the charges was particularly effective because the top charge exploded a fraction of a second earlier than the bottom charge. The top explosion tightly plugged the shaft with gases. When the bottom charge exploded, shock waves from it would rebound off the higher gas mass and rush back down and against the sides of the shaft and tunnels. This movement created a deadly overpressure between the two charges. The Soviets called this the "stereophonic effect" (Figure 3).[14]

The stereophonic effect can be multiplied by preparing two adjoining shafts for simultaneous detonation. The Soviets prepared each site as described above. Then they joined the detonation cord at the midpoint between the two shafts and taped the detonation cord to a standard hand-grenade fuze. When the charges were set off, a wider area of overpressure and destruction occurred. The Soviets called this the "quadraphonic effect" (Figure 4).[15]

A Fistful of Roman Candles

After the dust settled, the Soviets tossed a smoke pot down each shaft. The smoke is nontoxic and ventilation in a karez system is excellent. If the smoke disappeared, it meant that some tunnels were intact and that the search team could go in without wearing respirators. Search teams consisted of three or four men. Two of them would search to the front while the rest guarded their backs from a sneak attack from the rear. The lead man had a line tied to his leg. If the lead man found enemy materiel, he tied the line to it and rejoined the team so they could all drag it out. If the lead man was killed or wounded, his team members used the line to drag him back.[16]

The search group was armed with knifes, entrenching tools, hand grenades, pistols, and assault rifles.[17] A flashlight was taped to the forestock of the automatic rifles. The magazines of the assault rifles were loaded with tracer ammunition.

The Soviets developed a psychological weapon for underground combat using their SM signal mines. The SM is basically a Roman candle that shoots a series of red, green, or white signal stars from five to 20 meters. The signal mine simultaneously emits a siren-like sound. Although designed for trip-wire release by an unwary enemy, the SM can be safely ignited while holding it in one's hand. The Soviets taped from three to six signal mines together and, holding them in one hand, they ignited and fired them into a tunnel. A brilliant shaft of light, screams of sirens, and a fountain of signal stars filled the tunnel for nine seconds. The signal stars ricocheted off the tunnel walls like tracers. When the mines stopped, the Soviets found the unsuspecting foe covering his head with his arms, even though there was no real danger unless a signal star hit someone in the eye.[18]

Flame, Fuel-Air Explosives, and Fuel

Flamethrowers were also used against those hiding in the karez. The Soviets had replaced their short-range LPO-50 backpack flamethrowers with the RPO-A flamethrower. The RPO-A is a disposable system with a maximum range of 1,000 meters, a maximum effective range of 600 meters, and a minimum range of 20 meters. The round is 93 mm in diameter. It has three types of projectile: thermobaric (fuel-air), incendiary, and smoke.[19] The fuel-air round was most effective against the karez. The problem was that flamethrower gunners drew more enemy small-arms fire than radiomen. An incendiary round from an RPO-A could clear out any opposition on the surface around a shaft entrance, but no flamethrower gunner wanted to lean over the mouth of a karez to fire down the shaft—the gunner might be shot before he could fire a round. The Soviets developed the following method for these tunnels: Soldiers first secured the shaft entrance and then locked and cocked an RPO-A

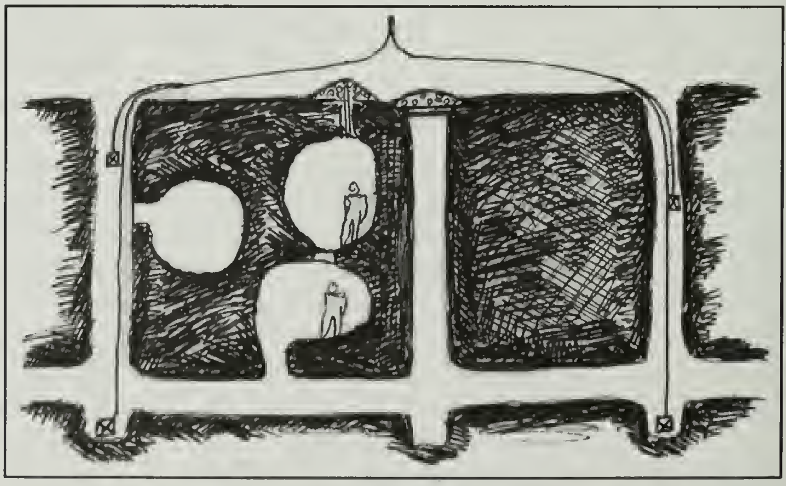

Figure 4

flamethrower with a thermobaric round. After tying two lowering lines on the RPO-A and a string on the trigger, they slowly lowered the RPO-A down the shaft until it faced a tunnel. Then they pulled the trigger string to fire the thermobaric round down the tunnel. The resulting overpressure of the fuel-air round was devastating for anyone in the vicinity.[20]

In the early days of the war, the Soviets reportedly used POL (petroleum, oil, and lubricants) products against those hiding in the karez. In the spring of 1982, Soviet soldiers entered the village of Padkhab-e Shana in Logar Province. A karez passes through the village and many villagers took refuge in it. According to eyewitness reports, "...villagers who fled spoke of soldiers wearing gas masks, pouring mysterious things into an underground irrigation canal where villagers, including children, were hiding. Our investigation showed that the soldiers had actually used gasoline, diesel fuel, and an incendiary white powder, an evil-smelling [substance] designed to ensure that the gasoline would properly burn in a tunnel with little oxygen. After the 105 people, including the little children, were burned to death, the population in a panic decided to run away to Pakistan."[21]

There were also many reports that Soviet forces used chemical agents during the early part of the war to flush out or kill mujahideen hiding in the karez.[22]

Tunnel Rats and Future Conflicts

Digging the enemy out of tunnels appears to be a constant factor in guerrilla warfare, and the combat engineer always seems to be the first soldier called for the task. Differentiating innocent civilians from combatants underground will prove to be a challenge for combat engineers. Since underground combat will not disappear from the future battlefield, we must prepare for the task. In the quest for high-technology answers to the complex problems of tomorrow's battlefields, there are few high-technology solutions for underground combat. After all the charges are blown, determined soldiers still must go underground to meet equally determined opponents. Specially trained soldiers will be better prepared to cope with future subterranean combat, which will remain the realm of raw courage, cunning, and nerve.

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Photos and artwork courtesy of the Russian *Soldier of Fortune* magazine, No. 11, 1994.

Endnotes:

[1] *Karez* is the Pashto term for the man-made underground water system. *Qanat* is the Arabic term used in Iran and Afghanistan. Louis Dupree, *Afghanistan,* New Delhi: Rama Publishers, 1980, page 40. Figure 1 is from page 41.

[2] Ibid.

[3] A. Bek, "Smertel'naya volna: Podzemnaya voyna v Afganistane" [Deadly wave: Underground combat in Afghanistan], *Soldat udachi,* [*Soldier of Fortune*], November 1994, page 4. This article is based on Colonel Bek's article and diagrams 2, 3 and 4 are Colonel Bek's.

[4] Dupree, page 40.

[5] Ali Jalali, *The Military History of Afghanistan,* Volume 1, Kabul, 1964, pages 437-442.

[6] Accounts of mujahideen commanders from Ghazni Province made to Ali Jalali in 1984.

[7] Bek, page 5. Lieutenant Colonel Bek ran this school.

[8] Afghanistan has two species of cobra, the deadly krait, and many types of vipers. Dupree, 53.

[9] Most Afghans would state that they seldom, if ever, gave warning.

[10] Fragmentation grenades, such as the cast-iron body Soviet F-1, are fairly ineffective underground.

[11] Bek, page 5.

[12] The Italian TC 6.1 mine has about six kilograms (13.2 pounds) of explosive. Soviet engineers often used a box of TNT in lieu of a mine.

[13] Bek, page 5.

[14] Ibid.

[15] Ibid.

[16] Ibid, pages 5-6.

[17] The entrenching tool was a weapon of choice for Soviet soldiers in hand-to-hand combat. Elite forces normally kept a razor-sharp edge on their entrenching tools.

[18] Bek, page 6.

[19] Terry J. Gander and Ian V. Hogg, *Jane's Infantry Weapons 1995-1996,* Surrey: Jane's Information Group Limited, 1995, pages 203-204.

[20] Russian General Staff material that Mr. Grau is translating and editing for publication.

[21] Mike Barry, *International Afghanistan Hearing*, edited by the Committee for International Afghanistan Hearing, Oslo, 1984, as cited by M. Hassan Kakar, *Afghanistan: The Soviet Invasion and the Afghan Response, 1979-1982,* Berkeley, 1995, pages 234-235.

[22] State Department Special Report # 106, *Afghanistan: Three Years of Occupation,* Washington: U.S. Government Printing Office, December 1982, page 5.

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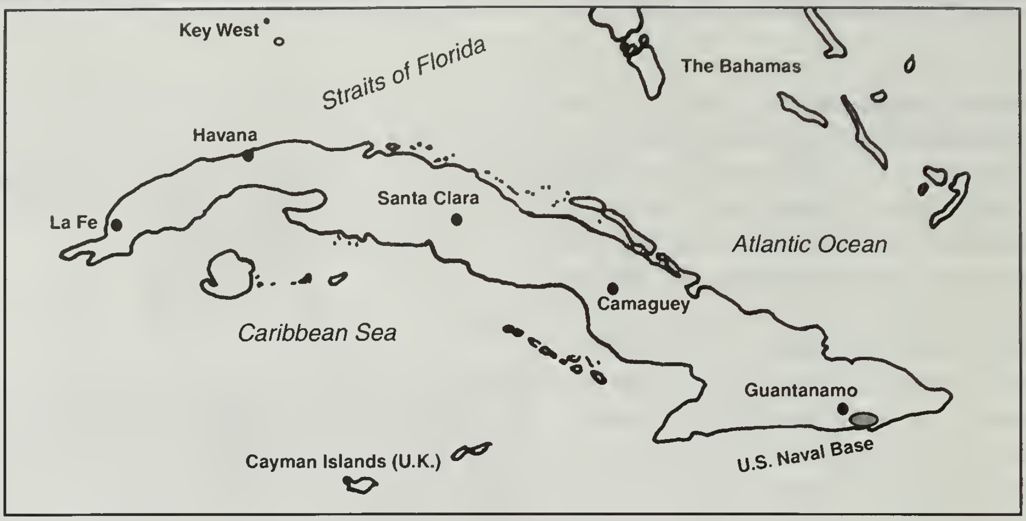


Guantanamo Bay:

Combat Engineering Don't "Gitmo" Better Than

By Captain Anthony J. Monaco, USMC

Commonly dubbed "Gitmo," the U. S. Navy's unique base on Cuba's southeastern coast has long been a showcase of naval expeditionary engineering capabilities. Originally seized by Marines as an advanced base for the Santiago Campaign of the Spanish-American War in 1898, Guantanamo Bay has been well used throughout the last century. The sheltered harbor, its position near the windward passage (an important maritime route between the United States and Central and South America), and its proximity to the Panama Canal make the base strategically important. Its airfields and extensive supply, repair, and training facilities make Gitmo an excellent forward-based naval facility. In 1961, though, the base was forced to turn its focus inland after escalating tensions between the United States and the Cuban revolutionary government resulted in a serious threat to base security. In response to that threat, Gitmo severed all local ties, closed its gates, and assumed a defensive posture. Since then, Gitmo has been surrounded on three sides by a less-than-cordial neighbor—the Cuban Army's Guantanamo Division.

In this real-world setting, U. S. sailors and Marines, though vastly outnumbered by their potential adversaries, continue to prepare to impede a Cuban attack on the base. The tenuous defense has relied heavily on combat engineers to shape a maneuver-constrained battlefield and to protect the force from the direct- and indirect-fire advantage afforded

A Russian-made H1P8 helicopter patrols Gitmo's perimeter. A U.S. observation post is on the left and a U.S. minefield is in the foreground. Two Cuban observation posts are at the top of the hill.

the Cubans by their superior numbers and occupation of high ground around the base's perimeter. Along with providing a more credible defense, U.S. Navy and Marine countermobility and survivability efforts at Gitmo have firmly established combat engineering's value as a combat multiplier. This article describes these combat engineering efforts and shows their arduous, occasionally ingenious, and at times costly development and integration into the defense. Some valuable lessons learned along the way are highlighted.

Weather, Terrain, and Obstacles

Gitmo is unique in the Caribbean in that it is not lush and tropical like nearby Jamaica and the Bahamas. Because of its seaside location, tropical heat and humidity are prevalent. Mountain ranges across Cuba's eastern end and mountains in Hispaniola block storms and rain, rendering the Guantanamo region semiarid. In most places, Gitmo resembles Arizona's desert more than it does a Caribbean island. Dense, gnarled chaparral, mangroves, and various scrub trees flourish in this climate. Because of the nearby ocean and intense tropical sun, the salt spray on vehicles, equipment, field fortifications, and obstacles is highly corrosive. There is no cool, dormant season to provide a break from the weather. High temperatures in the summer average in the mid- to high 90s, while winter highs average in the high 80s to low 90s. The temperature rarely drops below 70 degrees. Adding to its desert-like character is the lack of any naturally occurring freshwater source within four miles of the base.

Defenders usually pick terrain that affords them a distinct advantage over would-be attackers, but little about Gitmo's terrain favors the defense. From the island's eastern mountains and five key high points just outside the base, Cubans can view almost everything that occurs within Gitmo's fences. Terrain on the base is rugged and unwieldy due to the confluence of volcanic and coral geographies. Steep hills with loose, rocky slopes cover much of the base, although salt marshes and mangrove swamps also are common. Despite the relatively small amount of rainfall—an average of 23 inches per year—erosion control and soil stabilization are perpetual necessities on the many combat roads and trails in the defensive area. Even from the best positions on base, defenders must cover at least a dozen mechanized, small-unit avenues of approach that funnel into the base from concealed positions inside Cuba.

Several man-made obstacles and physical limitations further constrain American defenders. The first is the base's boundaries, which were set by treaty in 1934. The United States anticipated having to defend against an attack from the sea, so it took only the land needed for a coastal defense of the base and harbor. The boundaries were drawn along straight north-south or east-west lines, often cutting directly over the top of key terrain features and stopping short of several prominent, and later tactically critical, hills and ridges. When the threat shifted inland, the boundaries drawn three decades earlier became an instant liability to the land-based defense. In 1983, Castro eliminated the possibility of Americans branching into Cuba to gain valuable maneuver space by seeding the Cuban side of the perimeter with thousands of landmines.

Another lasting effect of the treaty is that the base boundaries do not encompass the entire bay, merely the lower bay. The bay divides the naval base into two distinct sides, called *leeward* and *windward*. No bridges connect the two sides and travel between them is limited to boat and helicopter. The channel to the upper bay contains an important Cuban agricultural port and must, by treaty and international maritime law, remain open—at least during peacetime. The effects of this diplomatically imposed obstacle on maneuver and the defense are especially constraining.

In total, Gitmo's intense, difficult climate, coupled with its rugged, unforgiving terrain and vegetation are natural enemies. In the preparation and maintenance of a sound defense, these factors exact a heavy toll on both men and machines. At best, the terrain and weather are equally harsh to attacker and defender. At worst, adding the diplomatic foibles of yesteryear, they favor the attacker. He holds key terrain outside the base and can direct a multipronged attack through many avenues of approach to literally push the undermanned Marines and sailors into the bay from whence they came in 1898.

Developing a Defense, 1958-1964

The buildup of Gitmo's initial land-based defense corresponds with the rise in national-level tensions with Cuba and the general panic over the spread of communism in our backyard between 1958 and 1964. Before the late 1950s, the base had no well-delineated perimeter road, and its boundary was marked only by an unsubstantial picket fence. Marines occasionally patrolled the perimeter on horseback. Marine engineers conducted training at Gitmo but were not used or needed in its defense before this period. In June 1958, Castro's rebels elevated local tensions when they kidnapped a group of 28 Marines and sailors who were returning to the base from liberty in Guantanamo City. (They were returned in July 1958.) Castro officially claimed control of Cuba on 1 January 1959, and Cuban-American diplomatic relations plummeted until 4 January 1961, when President Eisenhower terminated them completely. In concert with this termination, the base closed its gates, began regular patrolling of the perimeter, and started work on its defense. The Bay of Pigs fiasco in April 1961, the Cuban Missile Crisis in October

Photograph courtesy U.S. Navy

General L.F. Chapman, Commandant of the Marine Corps, is briefed on Gitmo's defensive preparations in 1971.

1962, and various provocations by Castro's forces around Gitmo's perimeter during this period yielded an urgency to defense planning and preparations on the base.

The United States initially reacted to the tension threatening Gitmo in the early 1960s by throwing large numbers of combat and combat support troops into the fray. Although the naval base commander was responsible for defending the base's 17.4-mile perimeter, he exercised it through the commander of Ground Defense Force, a Marine colonel who was commanding officer of Gitmo's Marine Barracks. The force, equipped and manned to hold out for up to a week without reinforcements, was comprised of a regimental-sized infantry component augmented by several provisional Navy companies. It boasted an impressive array of combined arms—from Marine artillery, tank, antitank, and engineer units to Navy attack airplanes and gunfire platforms. A Seabee battalion dug in the force and created the initial field fortifications and revetments.

The initial defense reflected the prevalent tactical thought of the period. Navy and Marine planners deployed a large, static force in hold-at-all-cost positions along the entire perimeter and strengthened it with impressive firepower. Engineer efforts, always the most time-intensive on the battlefield, were limited because the defenders, aptly figuring on the inevitable Cuban attack, were only willing to gamble on a minimal amount of preparation before the defense needed to be set.

Field fortification construction and minefield emplacement topped the engineers' tasks. Marine infantry—trained and supervised by Marine engineers—installed protective, standard-pattern minefields during lulls in the tension. Everything about these initial minefield efforts reflected the urgency of the defensive situation. The minefields did not maximize use of the terrain or incorporate sufficient man-made, nonexplosive obstacles. Minefield records were hastily drawn and often incomplete. Probably because of working long hours in the Cuban heat at a dangerous, unforgiving task, two junior Marines were killed in separate minefield accidents within a three-month period. As further evidence of the haste of these efforts, Marine Barracks staff members studying the continued requirement for landmines at Gitmo in late 1966 could find no record of the initial emplacement authority and few records on the initial efforts.

Changing the Focus, 1965-1966

As tensions around the perimeter relaxed about 1965, the American troops protecting Gitmo were slowly parceled out elsewhere. As American involvement in Southeast Asia grew, only a skeleton of the former force was left to defend against the still-credible Cuban threat. At this point, combat engineering earnestly entered the forefront of defensive preparations at the naval base. The new situation demanded that defenders make the best possible use of all combat multipliers. General Douglas MacArthur's prophecy began to be fully realized at Gitmo in 1965: *"...It is certain that in future wars, even more than in the past, endeavors will be made by every possible means to prevent or delay the march of the enemy's troops by throwing obstacles in the way and by cutting such lines of communication as they might use."*

The new defensive situation, featuring the tropical version of a Soviet-styled mechanized force, provided the impetus for a large-scale, combat-engineer-intensive defense retooling. The Marine Barracks exchanged its obsolete continuous perimeter defense for a mutually supporting strongpoint defense that relied heavily on an obstacle belt to disrupt, channel, or turn potential attackers. To effect this end, Marine engineer companies from Camp Lejeune, North Carolina, rotated to Gitmo in 1965 to plan and construct a more tactically sound obstacle belt around the perimeter. This retooling took more than a year of steady work to complete.

Engineer tasks were plentiful and the pace of implementation rapid. Seabees continued to assist the Marines with survivability efforts by fortifying strongpoints and artillery, mortar, and tank positions. They also expanded the network of combat roads and trails on rugged ground in and around the strongpoints, making reinforcement and maneuver between them more feasible.

Navy and Marine planners determined that landmine warfare was still a vital component of the Gitmo defense. They also recognized that the minefields emplaced from 1961 to 1962 were sorely in need of rehabilitation and better incorporation into a long-term defense plan. Marines removed or modified the minefields and emplaced several new ones. Guided this time by sound obstacle-employment principles and not nearly as hurried as their predecessors, the Marines tied 21 minefields, covering more than 600 acres of ground, into natural terrain obstacles such as salt marshes and steep hillsides. More than 41,000 M15 Heavy Antitank Mines, M14 "Toe Popper" Antipersonnel Mines, and M16 Bounding Fragmentation Antipersonnel Mines were used in these minefields. The Marines also built and incorporated substantial wire entanglements, tank ditches, and other nonexplosive obstacles into the obstacle belt. These efforts allowed the smaller, yet better-protected force to deploy behind a solid, well-planned, complex obstacle belt; fight a combined arms defense, albeit at closer range than desired; and reasonably expect to deter Cuban forces until help arrived from the United States.

Refining the Plan, 1967-Present

The Marine Barracks, later called the Marine Barracks Ground Defense/Security Force (GD/SF), continued to refine its defense plan. The more reasonable "live to fight another day" precept led the GD/SF to develop a delaying defense and abandon the outmoded "die-in-place" one. Along with the old strongpoints, this defense ultimately incorporated the more fluid concepts of battle positions, planned engagement areas, counterattacks, and phased fallback positions. The combined effects of this defense bought the time needed to evacuate noncombatants and allow reinforcements to build up in the rear area.

Refinements to the defense plan generated more engineer tasks. Though not in the numbers of the early and mid-1960s, Marine and Seabee engineer units continued to answer the call with regular deployments to the base, making the "smarter-not-harder" defense possible.

Field Fortifications

A prime focus for the deployed engineers was to maintain and upgrade the many field fortifications. Because of harsh environmental conditions, the fortifications—most of which relied on structural-grade timbers—had to be continually checked, repaired, and often rebuilt in order for them to remain an effective part of the defense. The destructive effects of the omnipresent Cuban termites and carpenter ants compounded the situation. These pests destroy wood structures at an alarming rate. To combat their effects, Marines treated fortification timbers with thick applications of creosote.

Obstacle Belt

Marines and sailors continued to work together to maintain and improve the obstacle belt. The minefields remained the focus; Marine engineers and Navy corpsmen, ordnancemen, and explosive ordnance disposal technicians worked together daily in minefield rehabilitation operations. One of the more ingenious additions to the countermobility plan was the "Valley of Balls" reinforcing obstacle, the product of a Gitmo-unique recycling effort. From the early 1900s until the end of World War II, the entire Atlantic Fleet sailed to Guantanamo Bay for training and anchored throughout the bay. To accommodate this massive force, the Navy placed several hundred floating anchorages—large, steel spheres and cylinders—in the bay for ships to tie to. Once the fleet stopped deploying to Gitmo in large numbers after World War II, the Navy tried to rid the bay of the anchorages, which had outlived their usefulness and were hazardous to boat traffic. The solution was to use the anchorages as antivehicle obstacles. Placed in offsetting rows along vulnerable terrain—in this case two small valleys—the anchorages further strengthened the effort to deny attackers the use of key avenues of approach.

Observation Posts

Another sizable engineer task during this period showcases the well-known "can-do" motto of the Seabees. During their regular deployments, Seabees built 10 substantial timber-tower observation posts along the perimeter. Designed and built to withstand the effects of hurricane-force winds, these towers were significant undertakings. They were fitted with steel plating at the top to protect sentries from small-arms potshots from the other side. Placed on the highest ground available along the perimeter and usually standing about four stories high, the posts partially mitigated the American disadvantage in observation. The posts were crucial to the 24-hour surveillance of the perimeter. From these towers, guards could gain early warning of potential Cuban hostilities and constantly monitor daily activities of Cubans for later analysis by intelligence personnel. The towers also allowed Marines to effectively control the heavy influx of Cuban asylum seekers who came through the fence line in the early to mid-1990s.

Gitmo's Own Engineers

Early in 1968, the Marine Barracks received its own permanent combat engineer unit for rehabilitating the base's 700 acres of minefields. Called the Minefield Maintenance

Engineers upgrade the obstacle belt in 1997.

(MFM) Section, the unit included highly trained landmine warfare experts, all of whom held the rank of sergeant (E5) and above. The MFM Section relieved deploying Marine engineers of dangerous minefield work. Previous landmine operations had caused heavier-than-expected casualties to these units, claiming five lives and wounding several others between November 1965 and November 1966.

The MFM Section continued to upgrade and expand the minefields to better meet the needs of the defense plan, raising the total number of mines to more than 55,000, the total minefield acreage to more than 700, and the total number of minefields to 26. The MFM Section's daily efforts centered on locating and removing old mines and replacing them with newer, more effective ones, ensuring that Gitmo's minefields remained the highly effective backbone of the obstacle belt. One maintenance rotation, which involved removing and replacing all the mines and inspecting and repairing the infrastructure of each of 26 minefields, took seven years to complete. Between 1967 and 1990, minefield operations continued to provide a sober reminder of the price of maintaining Gitmo's defense. During this period, six more Marines and five Cuban fence jumpers were killed and several other personnel were injured.

Adding the MFM Section also provided the GD/SF with a combat engineer capability to supplement its battle plans. Their integration increased the plan's flexibility and resulted in the development of several unique, ready-made obstacles. The obstacles, positioned for rapid tactical employment throughout the base, did not prohibit normal traffic patterns or other routine occurrences.

The preplanned obstacles illustrated more of the combat engineers' innovative contributions to Gitmo's defense. Similar in concept and design to the obstacles employed by U.S. Army engineers in Korea and West Germany during the Cold War, they included road craters and bridges that were prechambered for demolitions placement and falling blocks. Their construction emphasized quick, foolproof employment. The most prevalent of these obstacles were the prechambered road craters known as *blow holes*. Blow holes consisted of polyvinylchloride (PVC) pipe placed in the ground across the width of a road to maintain the holes into which cratering charges could be placed and ignited. The holes were tied together with a concrete cap, and metal lids were placed over the ends of the pipe. Everything was flush with the road surface. The prechambered bridges crossed antitank ditches, which were vital to the defense but obtrusive to the everyday business of perimeter surveillance. To blow the bridges and complete the obstacle, an MFM team would place predetermined quantities of demolitions in cradles welded to the underside of the bridge, tie the charges together, and fire the obstacle. In keeping with the foolproof use of these obstacles, instructions for blowing the bridge were stenciled on one of its abutments. The last of these obstacles were the falling blocks, called *monoliths*. Consisting of large concrete columns, they could be felled by a small "kicker" charge placed in a space at the bottom of each column. The columns would then fall inward and block the road.

The basic battle concept was for the MFM Section to be employed in mobile, four-man teams that served in general support of the GD/SF fight. The teams would be dispatched to initiate these obstacles at decisive junctures in the foreseen defensive battle, thus cutting off certain avenues of approach. This concept was especially important in Gitmo's shallow defensive area, because it allowed maximum use of the limited maneuver space for as long as possible and then quickly denied the enemy use of the same terrain as he pressed into the base. In case of a quicker-than-expected break in the lines, engineers could be employed as infantry—a bonus for the already lean defense force.

The Current Situation

Defensive operations at Gitmo have fallen to the same downsizing ax as the rest of America's military. Cuban forces around the base also have undergone changes, having lost their Soviet benefactor. However, the need for a credible defense has not dissolved and preparations continue, though on a more modest scale than in previous eras. Chief among these efforts—and one only recently completed—was the Seabee's repair and upgrade of the perimeter road. This road, the lifeline of the perimeter, had always been subject to damage from erosion and heavy tactical vehicle traffic. It was dangerous to drive on at night, the peak time for patrolling, and was badly in need of repair. The Seabees implemented a comprehensive plan to fix the problem that integrated soil stabilization, culverts, concrete ditches, gabions, and a double-bituminous, surface-treated road along the entire 17.4-mile perimeter. The Seabees have also completed another timber observation post and started building several storm shelters along the fence line for Marine sentries and patrols.

Countermobility operations have taken the biggest hit recently. The president's decision in May 1996 to ban the use and stockpiling of all antipersonnel mines was manifested in a directive to completely remove Gitmo's minefields. The MFM Section is carrying out this operation, but the work is necessarily deliberate, slow, and thorough and is not scheduled for completion until after the year 2000. The GD/SF continues to search for a viable replacement for the minefields and is considering scatterable mine systems like the Volcano and the Modular Pack Mine System or perhaps a nonexplosive alternative. Survivability maintenance has been affected too, but recent developments from the Army's experiences in Bosnia show promising applications at Gitmo. Survivability and countermobility projects continue to accumulate because too few engineer units are available to accomplish all of the proposed projects.

Lessons Learned

The evolution of Guantanamo Bay's defense has yielded the following combat engineering lessons:

❐ *Integrate combat engineers into the defense.* This includes individual engineers on the ground who coordinate with infantry as well as engineer leaders who integrate engineers into operations plans. The Marines' experience at Gitmo clearly shows the value of a combat multiplier that is often not fully employed in peacetime exercises, because many combat engineering tasks are too time intensive to complete.

❐ *Keep combat engineers in general support of the force.* At Gitmo, the MFM Section showed that they were more flexible if they stayed in general support of the GD/SF during defensive exercises rather than be task organized to subordinate units.

❐ *Integrate engineer and fire-support planning.* This lesson is especially obvious at Gitmo, where Marines can stand on an obstacle, look down the avenue of approach it seeks to deny, and clearly see the desired combined-arms effect.

❐ *Stress the importance of realistic "hands-on" training for junior sailors and Marines, training which often is not possible in the United States.* Because the defense mission takes top priority in Gitmo, there are few constraints—environmental or otherwise—to hamper digging, building, demolishing, etc. The operational nature of the mission infuses defenders and those who have deployed to Gitmo with a singular focus and sense of purpose. The result is that generations of Marines and sailors have taken valuable lessons learned at Gitmo to Vietnam, Beirut, the Persian Gulf, Somalia, and elsewhere.

❐ *Ensure that engineer leaders receive fire-support training.* Simulating the placement of demolitions in front of enemy and friendly lines when both sides are manning their positions—essentially working in "no man's land"—is a good way to remind everyone to brush up on call-for-fire and close air and radio communications skills.

❐ *Appreciate the difficulty, danger, and long-term consequences of minefield operations.* Conventional minefields require an incredible amount of resources and time to emplace and maintain. Minefields also present problems long after they have ceased to be tactically beneficial, regardless of the type of mine systems used. Friendly minefields produce casualties among even the most seasoned troops. These realistic considerations must be factored into our tactical planning.

❐ *Encourage innovation.* Some of Gitmo's most effective obstacles resulted from unlikely materials or bold ideas.

❐ *Stress simplicity.* Seemingly simple engineer tasks, such as priming a road crater or locating and removing mines from thick undergrowth, are not so simple when performed in view of an enemy guard tower. Working at Gitmo, with the nearby threat, shows how difficult it would be to do the same tasks in a combat situation.

❐ *Develop a unit standing operating procedure (SOP).* Although the MFM Section essentially followed established landmine warfare doctrine, the doctrine was by no means comprehensive enough by itself. The MFM Section found it necessary to develop thorough, stringent procedures for daily minefield operations. The use of the SOP by all Marines, regardless of rank, was undeniably a major factor in minimizing minefield casualties.

❐ *Minimize the potentially debilitating effects of terrain and weather on a defensive posture.* If not for a dedicated maintenance effort, there would no longer be any worthwhile positions or obstacles at Gitmo.

❐ *Emphasize the true relevance of the tenet "Every Marine a Rifleman."* The defense plan at Gitmo relies on the use of every Marine, regardless of specialty.

The Future

The defensive situation around the perimeter of the Guantanamo Bay Naval Base is one of only a few Cold War conflicts yet to be resolved. The future of the base and its defensive operations are currently unclear, and significant changes are likely as relations with Cuba

(Continued on page 32)

TerraBase II, Version 3.0

Supporting the Terrain Visualization Expert

By Mark Adams and Lieutenant Colonel Earl Hooper

The U.S. Army Engineer School continues its efforts to develop TerraBase II as an easy-to-use, low-cost, PC-based terrain evaluation tool for the engineer force. This software assists in training engineers to be terrain visualization experts and provides a personal software tool to evaluate and view digital terrain data products. TerraBase II is tailored specifically for military applications and requires minimal training. This article reviews the capabilities provided by version 2.2 and describes improvements available in the new 3.0 release.

> *"Terrain visualization is the responsibility of commanders and staffs across the spectrum of today's Army. To effectively see the impact that terrain has on units conducting and supporting military operations, all commanders and their staffs must be aware of the effects of terrain. The terrain expert is the engineer."*
>
> *Major General Robert B. Flowers*
> *Commandant, U.S. Army Engineer School*

Version 2.2 Capabilities

TerraBase II has been the instructional standard for the Engineer School since the summer of 1997. The Engineer School distributed the original 2.04 version of TerraBase II on a Terrain Visualization Training CD-ROM (see *Engineer*, August 1997, pages 38-39). The 2.2 version of the software was distributed via the web in April 1998. TerraBase II quickly reached the field with our graduating students and through the Terrain Visualization Center web site.

With TerraBase II, version 2.2, engineers can produce a variety of tactical decision aids (TDAs) to assist with terrain visualization. These include line-of-site displays, weapons fans and range circles, visible area plots, oblique and perspective views, elevation and slope tints, contour and reflectance plots, point elevations, and fly-throughs. TerraBase II also performs coordinate datum transformations and calculates sunrise-sunset day length, moonrise-moonset, and over-the-ground distance.

TerraBase II, version 2.2, a users' guide, and a set of battle drills are available from the Terrain Visualization Center web site at *http://www.wood.army.mil/TVC*. Each battle drill contains an abstract and step-by-step procedures to help new users develop basic TDAs.

The primary data requirements are imagery and elevation data products from the National Imagery and Mapping Agency (NIMA - formerly the Defense Mapping Agency), U.S. Geological Survey (USGS) and a variety of commercial products. The 2.2 version uses—

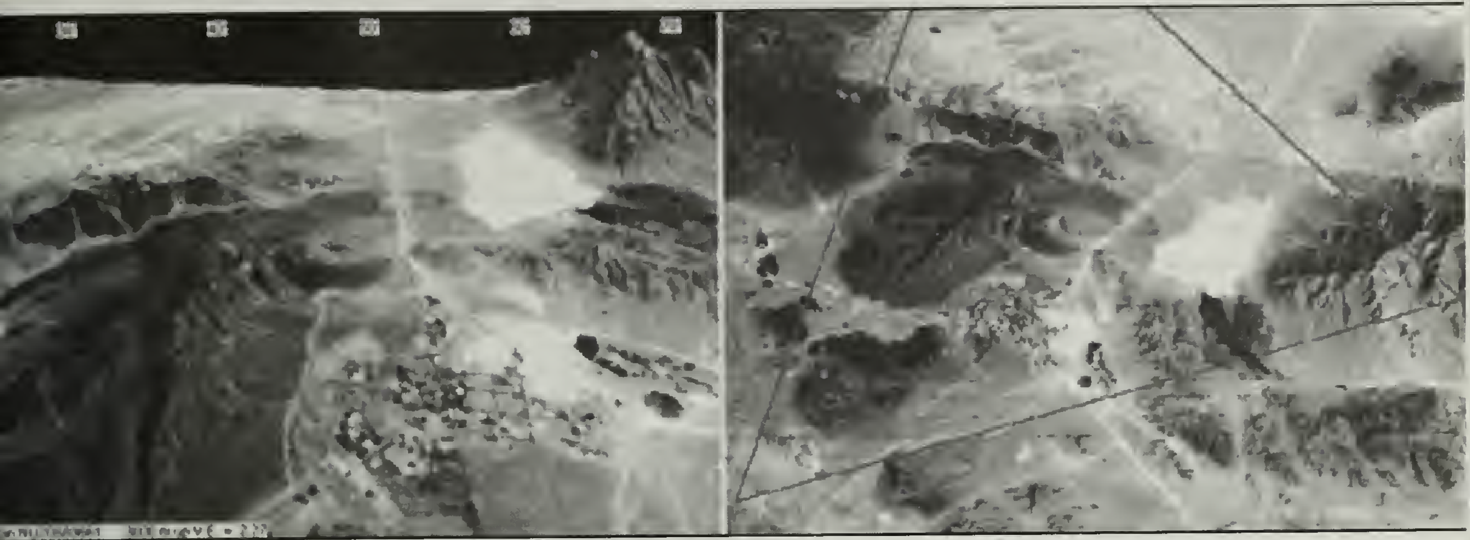
- NIMA digital terrain elevation data (DTED).
- USGS digital elevation models (DEM).
- NIMA controlled-image base (CIB).
- USGS digital orthophoto quads (DOQ).
- LANDSAT (land satellite) multispectral imagery (MSI).
- SPOT (Systeme Probatoire d' Observation de la Terre) satellite imagery.
- Indian reconnaissance satellite (IRS) imagery.

Version 3.0 Updates

Since the release of versions 2.04 and 2.2, a steady stream of questions, requests for assistance, recommended improvements, and bug reports flowed into the Terrain Visualization Center. The most useful information consistently came from users in the field, who add tactical significance to the TDAs produced with TerraBase II. The result of this input is TerraBase II, version 3.0. From the users' perspective, most of the improvements are evolutionary. Although many processes are simplified, the look and feel of TerraBase II remains unchanged. The following paragraphs summarize the most significant updates in version 3.0.

New Formats

Field users frequently requested map-based product formats. The 3.0 version adds digital map formats from NIMA and USGS that can be used to create TDAs, including perspective and fly-through products. New formats available in release 3.0 are—



An NTC fly-through (left view) with a corresponding two-dimensional track (right view).

- *NIMA standard data types:* Arc Digitized Raster Graphics (ADRG) maps, Compressed Arc Digitized Raster Graphics (CADRG) maps, and Compressed Digitized Raster Graphics (CDRG) maps.
- *USGS standard data type:* Digitized Raster Graphics (DRG) maps.
- New commercial and allied imagery in GeoTiff georeferenced formats.

Revised User Interface

Version 3.0 includes an expanded and simplified user "options" interface, improved pull-down menus, and a Graphics User Interface (GUI) for the most popular TDAs. This version also includes an updated coordinate conversion module and a "hot key" to execute the Topographic Engineering Center GEOTRANS software. The GEOTRANS software adds a Universal Polar Stereographic capability for the coordinates in polar regions, a few minor secondary grids, and the ability to batch-process coordinate conversions.

Improved TDA Presentation

Version 3.0 allows users to drape any of the tactical overlays (weapons fans, point elevations, annotations, custom grids, etc.) on elevation data, imagery, or maps to create two-dimensional, perspective, and oblique views. A curved-path fly-through is now possible with automatic smoothing of directional changes. The new fly-through interface simultaneously displays, frame by frame, both the fly-through three-dimensional view and the two-dimensional map track (see figure). Resolution restrictions on three-dimensional perspectives and fly-throughs are relaxed to take advantage of high-end PC capabilities.

GPS Connectivity

Military and commercial Global Positioning Systems (GPS) now can be connected to laptop computers and—in real time—display track, bearing, and speed, with updates every two seconds. The track can display over elevation data, imagery, and maps. Way points recorded using a military precise lightweight GPS receiver (PLGR) now can be downloaded and displayed in TerraBase II over elevation data, imagery, or maps. In a reverse role, routes planned with TerraBase II can be uploaded as way points to a PLGR for navigation.

Other Improvements

The help files in version 3.0 are greatly expanded and contain an automatic help feature for new users. Major changes in data retrieval and manipulation are embedded in the software that allow NIMA, USGS, and GeoTiff products to display in their native formats. Although TerraBase II still uses an internal.idx format for some products, most products load directly without the need for conversion. This capability greatly enhances the speed of creating TDAs and reduces file-storage requirements. Most importantly, it takes advantage of the geocontrol embedded in products from primary data providers.

Availability

TerraBase II, version 3.0 beta, may be downloaded from the new Terrain Visualization Center web site at *http://www.wood.army.mil/TVC/index.htm.* A revised users' guide and an updated set of battle drills are planned for release by the end of 1998. A new two-CD-ROM set is projected for completion early in 1999. The first CD-ROM will contain a self-paced interactive training program, while the second one will contain the TerraBase II software and an expanded set of training data. The Engineer School continues to support earlier TerraBase II releases, battle drills, and users' guides until version 3.0 is available on CD-ROM and the Terrain Visualization Center web site.

Sample digital elevation and satellite imagery data coverage for several CONUS training posts is available from the Terrain Visualization Center web site. The key source of data for training and operations continues to be the NIMA. Units can use their Department of Defense Activity Address Code (DODAAC) to order digital and hard-copy products from NIMA on a 30-day turnaround cycle. As of 1 April 1998, NIMA products are ordered and delivered through the Defense Logistics Agency and requested by national stock number using the Standard Army Retail Supply System. Department of the Army Deputy Chief of Staff for Logistics message (DALO-SMP, DTG 140858Z April 97) provides instructions. Map stock and issue procedures follow AR 710-2, *Inventory Management Supply Policy Below the Wholesale Level.* Mapping, charting, and geodesy products are stocked at Class II, IV, and VII supply points at Corps and the Theater Army Area Command. The Defense Supply Center web site at *http://www.dscr.dla.mil/PC9/dscr_maps.htm* provides information on the new ordering and distribution process. All NIMA products are provided at no cost to support military requirements.

Joint Venture

The TerraBase II developmental effort continues as a joint venture between the Engineer School's Department of Training and Doctrine Development (responsible for all training, instructional materials, and training support), the Terrain Visualization Center (responsible for software development management, priorities, and field technical support), and the U.S. Naval Academy (responsible for programming and software development).

Engineer School personnel are grateful to Dr. Peter Guth of the U.S. Naval Academy for his extraordinary skill and dedication to this project and to the U.S. Naval Academy for its flexibility and support of Dr. Guth's efforts This relationship allows TerraBase II to develop and respond quickly to user feedback. TerraBase II, version 3.0, is indicative of this cooperative relationship.

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Lieutenant Colonel Hooper is Chief of the Terrain Visualization Center, U.S. Army Engineer School. Previous assignments include operations officer, 30th Engineer Battalion (T)(A) and Corps engineer plans officer, XVIII Airborne Corps, Fort Bragg, North Carolina; and commander, 814th Engineer Company (AFB), Hanau, Germany. LTC Hooper is a graduate of the Airborne School, Ranger School, and Command and General Staff College. He holds an industrial engineering degree from the University of Central Florida and a master's degree in systems management from the Florida Institute of Technology.

(Continued from page 29)

continue to improve. That the defense has never been compromised, despite occasionally fierce posturing throughout nearly four decades, is testament to the resolve and skill of its defenders. Gitmo's tangible, unique defensive preparations, which showcase the competence and ingenuity of Marine engineers and Seabees, have shown that combat engineering is essential to mission success.

Captain Monaco is assigned to the 2d Combat Engineer Battalion, 2d Marine Division, Camp Lejeune, North Carolina. Previous assignments include OIC, Minefield Maintenance Section and Barracks Engineer, Marine Barracks, Guantanamo Bay, Cuba; platoon commander, engineer officer, and S3A, 3rd Light Armored Reconnaissance Battalion, 1st Marine Division, 29 Palms, California; and platoon commander, 9th Engineer Support Battalion, 3rd Force Service Support Group, Okinawa, Japan.

References:

"Bienvenido." Public Affairs Office pamphlet, U.S Naval Station, Guantanamo Bay, Cuba. 1993.

"Brief History of the Marine Engineer." An unpublished paper by Ralph W. Donnelly). September 1983.

Contesting Castro. Thomas G. Patterson. New York: Oxford University Press, 1994.

FM 5-102, *Countermobility.* Department of the Army, March 1985.

FM 5-103, *Survivability.* Department of the Army, June 1985.

FM 20-32, *Mine/Countermine Operations.* Department of the Army, September 1992.

FM 100-5, *Engineer Combat Operations).* Department of the Army, November 1988.

"Guantanamo: Keystone in the Pacific Caribbean." Jules B. Billard. *National Geographic Magazine*, Vol. 119, No. 3, March 1961.

Interviews with Mr. Jack L. Neill, March 1996 to March 1998.

"Landmine Trauma in Guantanamo Bay, Cuba, 1962-1983." An unpublished paper by David B. Adams, M.D., 27 September 1983.

Marine Barracks Historical Files. Maintained by the Barracks Historical Officer at the Marine Barracks, Guantanamo Bay, Cuba.

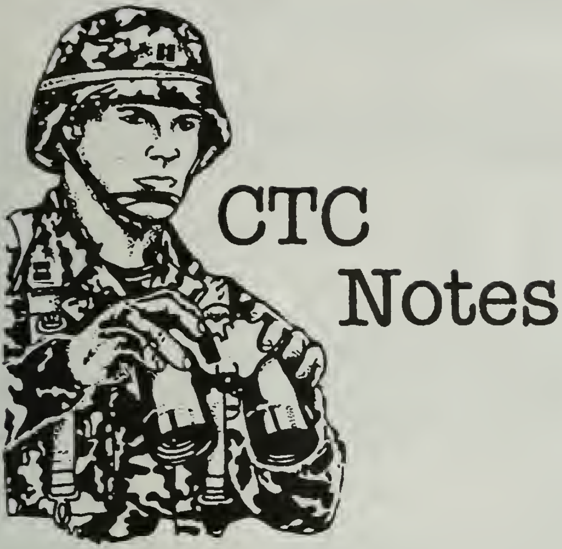
Minefield Maintenance Files. Maintained by the MFM Section Office, Guantanamo Bay, Cuba.

Minefield Maintenance Standard Operating Procedures (Marine Barracks Order P8092.1M). May 1996.

"Revisiting the Cactus Curtain." Byron D. Varner, USN (Ret). *Keeping Apace Magazine.* Summer, 1996.

Seawolf: The Biography of Admiral Bulkeley. W. Brever, 1988.

"Study of Landmine Warfare Operations and Requirements at the U.S. Naval Base, Guantanamo Bay, Cuba." 25 November 1966.



National Training Center (NTC)

Breach Planning at the Brigade Level

By Captain Fred Erst

During offensive operations, maneuver brigades often struggle with isolating the point of penetration and massing sufficient combat power at the decisive point on the battlefield. As a result, many brigades are unable to set the conditions for the fight before committing to the breach and are rapidly destroyed by the defending enemy. Many of these problems can be traced back to ineffective breach planning by both the maneuver brigade and the engineer battalion.

The maneuver brigade staff does not consistently recognize or include the breach as a significant phase of the operation during course-of-action (COA) development and war gaming because enemy obstacles are not adequately depicted in the brigade's situation template (SITEMP). The brigade's main effort is not weighted with sufficient combat power to conduct a penetration and lacks the additional mobility assets required to provide redundancy at the breach. While the assistant brigade engineer (ABE) understands how to use reverse breach planning, the brigade staff does not use the reverse planning process to develop the brigade's scheme of maneuver. The breach plan does not address brigade responsibilities for a task-force breach nor does it specify how the brigade intends to synchronize the SOSR (suppress, obscure, secure, reduce) fundamentals.

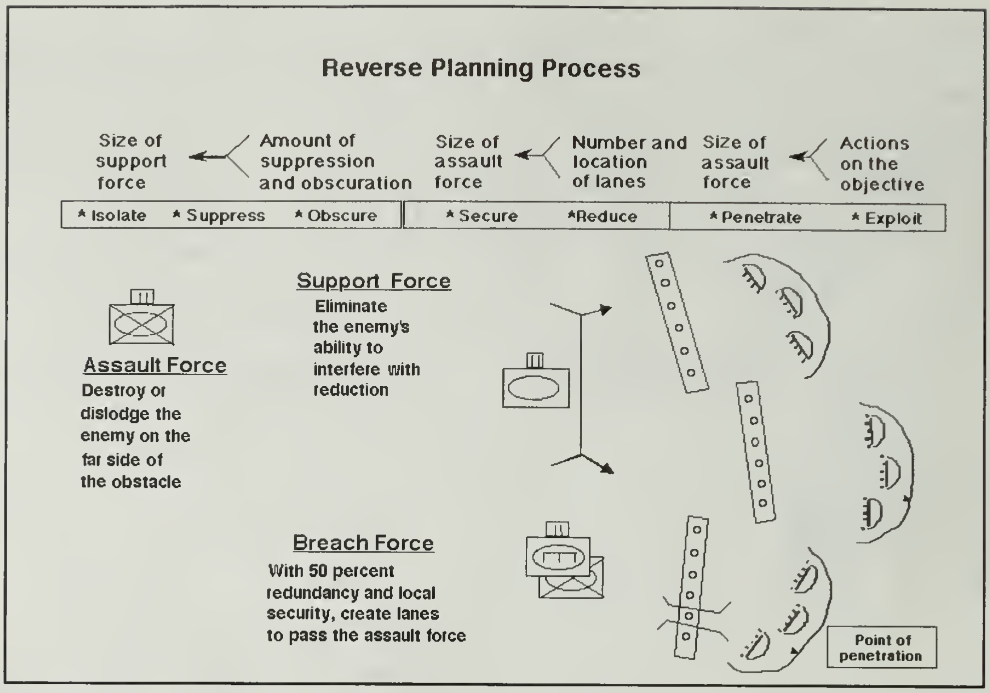
To improve breach planning at the brigade level, the engineer battalion and maneuver brigade staff should focus their efforts on the following five areas:

- Engineer Integration in the intelligence preparation of the battlefield (IPB)
- Breach organization and mass
- Reverse planning process
- Actions at the breach
- Brigade responsibilities at the breach

Specific actions for each area follow.

Engineer Integration in the IPB. Effective breach planning must begin during the brigade's IPB process. The ABE and engineer battalion S2 must develop and use the engineer battlefield assessment to provide the brigade commander and staff with a common vision of how they believe enemy engineers and the terrain will shape the battlefield. The ABE and engineer S2 must work closely with the brigade S2 to template all possible enemy obstacles throughout the depth and width of the battlefield based on each enemy course of action. To provide the necessary focus during the brigade planning process, they must ensure that enemy tactical and situational obstacles are included in the brigade SITEMP. This includes minefields emplaced by the mobile obstacle detachment, the universal mine layer, and rocket-delivered scatterable mines, as well as expected enemy positions and weapons systems. A detailed brigade SITEMP is an essential part of developing an effective breach plan. The brigade SITEMP provides the common vision of the enemy needed to drive the brigade's reverse planning process, task organization, and reconnaissance planning early in the military decision-making process.

Breach Organization and Mass. The *size* of the enemy force overwatching the obstacle drives the *type* of breach the brigade conducts (brigade versus task force). The brigade staff must consider the enemy's ability to mass combat power and reposition his forces or commit his reserve. The brigade must then develop a scheme of maneuver to mass sufficient combat power at the decisive point on the battlefield. FM 71-3, *The Armored and Mechanized Infantry Brigade*, states "Massed combat power is directed against an enemy weakness. The location selected for breaching depends largely on a weakness in the enemy defense where its covering fires are minimized. If the attacker cannot find a


Reverse Planning Process
Size of support force
Amount of suppression and obscuration
Size of assault force
Number and location of lanes
Size of assault force
Actions on the objective
* Isolate
* Suppress
* Obscure
* Secure
*Reduce
* Penetrate
* Exploit
Assault Force
Destroy or dislodge the enemy on the far side of the obstacle
Support Force
Eliminate the enemy's ability to interfere with reduction
Breach Force
With 50 percent redundancy and local security, create lanes to pass the assault force
Point of penetration

natural weakness, he creates one by fixing the majority of the defending force and isolating a small portion of it for attack. The need to generate enough mass strongly influences which echelon can conduct a breaching operation...A task force has sufficient combat power to attack an obstacle defended by a company."

The success of a task force breach depends on the brigade's ability to isolate that portion of the enemy defense that the lead task force has the ability to penetrate. Otherwise, the brigade must organize for a brigade-level breaching operation. A brigade with one armor and one infantry task force can designate one unit as the support force and the other as the assault force. The brigade can then use the engineer battalion (with a security and reduction element) to serve as the breach force. By organizing for a brigade-level breach, the brigade can mass the combat power and mobility assets needed to successfully isolate and penetrate a motorized rifle battalion defense.

Reverse Planning Process. The reverse planning process is an essential tool in building an effective plan (see figure above). The end state is not the breach; rather it is getting the assault force onto the objective to destroy the enemy. By starting at actions on the objective and working back to the line of departure, the staff can allocate combat power, mobility assets, and indirect fires (suppression/smoke). The following list is based on the technique shown in FM 90-13-1, *Combined Arms Breaching Operations,* and is supplemented with lessons learned during breaching operations:

1. Actions on the objective drive the size and composition of the assault force, the assault force objective, and the point of penetration (POP).

2. The size of the assault force and location of the POP determine the quantity and location of lanes.

3. Lane requirements, type of obstacles, and type of terrain/soil drive the amount and type of mobility assets (i.e., size and composition of the reduction element) task organized to the breach force.

4. The size and composition of the security element in the breach force are based on the enemy's ability to interfere with obstacle reduction.

5. The amount of suppression and the size, composition, and location of the support force are driven by the enemy's ability to mass fires and interfere with the breach at the reduction site.

Actions at the Breach. The brigade's operations order (OPORD) must specify brigade actions at the breach required to achieve SOSR for either a brigade- or task-force level breach. An effective technique is to sketch these actions at each expected breach site based on the templated obstacle, the specific terrain, and the enemy positions. The actions are found in FM 71-1, *Tank and Mechanized Infantry Company Team*, and can be applied to brigade or task force breaching operations.

- The reconnaissance force identifies the reduction site.
- The support force occupies positions and begins suppressive and obscuration fires.
- The breach force establishes near-side security at the reduction site.
- The breach force reduces the obstacle.
- The breach force proofs and marks lanes and establishes far-side security.
- The asssault force assaults and secures the objective.

SOSR Criteria

Decisions	Criteria
Determine the point of penetration and reduction site	- Reconnaissance force identifies obstacles and enemy positions.
Commence suppression and obscuration fires	- Observers are in position. - Support force crosses phase line.
Support force occupies support-by-fire (SBF) position	- Critical friendly zone (CFZ) is in place over the SBF position. - Obscuration is in place to screen support force movement. - Support force maintains more than 70 percent of its combat power.
Commit the breach force	- Suppression and obscuration are adjusted and effective. - CFZ is in place over the reduction site. - Engineer preparations are complete. - Fire-control measures are in effect.
Commit the reduction element	- Breach force near-side security is in position. - Security element controls the reduction site by fires or occupation.
Commit the assault force	- Lane is reduced, proofed, and marked. - Far-side security is in position.

The staff should develop a time line for these actions at the breach to ensure that the brigade maintains momentum during the attack. The brigade OPORD should specify the task and purpose of each element of the breach organization needed to achieve SOSR. The staff should also develop and track criteria for achieving SOSR to assist the commander in determining if breach conditions have been achieved. A method for establishing the criteria is shown above. *(Note: These criteria are not all-inclusive).*

Obscuration Plan. The brigade staff should develop a time line for critical actions at the breach for both the support force and the breach force as constrained by available smoke. Specify the task and purpose of both projected and generated smoke. Allocate or task organize smoke assets to the support force and the breach force based on those requirements. Develop solid triggers to employ obscuration and specify who controls obscuration. Ensure that the support force commander controls/shifts artillery-projected smoke needed to obscure his movement into the SBF position and set conditions for the breach.

Fire Control Plan. Identify fire-control measures in the brigade graphics such as SBF positions, coordinated fire lines or restricted fire lines, and no fire areas. All elements of the breach organization must specify and discuss direct fire-control measures such as target reference points (TRP); phase lines; and signals to initiate, lift, shift, or cease fires.

Brigade Responsibilities at the Breach. Engineers must ensure that brigade responsibilities during a brigade- or task-force breach are defined in the brigade's breach plan.

Obstacle Intelligence. Current and accurate obstacle intelligence (OBSTINTEL) is necessary to confirm or deny the SITEMP. FM 5-170, *Engineer Reconnaissance*, states that OBSTINTEL allows the commander to refine the plan and set conditions for a successful combined arms fight; maneuver rapidly to the objective; and exploit the opportunities offered by obstacles, terrain, and the enemy. The engineer battalion S2 and ABE must assist in developing the brigade reconnaissance and surveillance (R&S) plan. Task force scouts and the brigade reconnaissance troop must be trained to collect detailed OBSTINTEL. Any effort to conduct engineer-specific reconnaissance must be integrated with the brigade R&S plan. Both maneuver scouts and engineer reconnaissance teams (ERTs) are given parts of the same task to accomplish; both must maneuver through and occupy the same area during reconnaissance missions; and both must be able to report using retransmission, relay, or tactical satellite communications. FM 5-170 also states that integrating maneuver scouts and ERTs provides close cooperation and mutual support, decreases reconnaissance overlap, and reduces the risk of fratricide.

Isolating the Point of Penetration. The brigade plan must synchronize combat multipliers to isolate the point of penetration. The brigade staff must use close air support, artillery, aviation, electronic warfare, scatterable mines, air defense, obscuration, and deception to set conditions for the fight. Additionally, the brigade must continue to fight deep to stop the enemy from repositioning or counterattacking.

Traffic Control at the Breach. The brigade must task military police to provide maneuver mobility support to control traffic at the lanes, especially if the scheme of maneuver involves a passage of lines. The brigade breach plan should also specify a lane-numbering system, identify traffic-control points, and state which lanes will support reverse-flow traffic to evacuate casualties.

Conclusion. To achieve mission success, the maneuver brigade must isolate the point of penetration and mass sufficient combat power and mobility assests at the decisive point on the battlefield. Effective breach planning enables the brigade to maneuver rapidly and pass the assault force onto the objective to destroy the defending enemy. By improving breach planning at the brigade level, the maneuver brigade and engineer battalion can set the conditions for mission success.

Captain Erst is the assistant brigade engineer trainer at the National Training Center, Fort Irwin, California. He previously served as a company commander in the 3rd Engineer Battalion/10th Engineer Battalion and as a platoon leader/company XO in the 4th Engineer Battalion. He is a graduate of the University of Central Florida.

Battle Command Training Program (BCTP)

Improving Efficiency of Engineer Command and Control Nodes

By Lieutenant Colonel Ron Light

Recent BCTP Warfighter exercises indicate that engineers struggle with the functions and roles of engineer command and control (C2) nodes within the division area. Many units' standing operating procedures (SOPs) are incomplete and fail to clarify functions and roles. Details about *which engineer C2 node performs which tasks, where,* often are unclear. Units that have achieved success in the C2 arena blend their own tactics, techniques, and procedures (TTPs) with current engineer doctrine (FM 5-100, *Engineer Operations,* and FM 5-71-100, *Division Engineer Combat Operations*).

The division commands and controls operations through a command group and three command posts (CPs): the division rear CP, the division main CP, and the division tactical (TAC) CP. Engineers integrate the mobility and survivability battlefield operating system (BOS) at each of these CPs. Engineer functions at each C2 node interrelate, and the overall success of efforts to synchronize engineers rests in part with each node. Because staffing levels and experience at each C2 node differ, their productivities also differ. Some of the TTPs units use to increase the synchronization of engineers within the C2 nodes follow.

The Division Engineer Main CP

The division engineer (DIVEN) MAIN CP serves as the nucleus of the division engineer C2 organization. To mitigate staff inexperience and personnel shortfalls, successful units establish the DIVEN MAIN CP as the hub of information collection, analysis, and dissemination. The executive officer (XO) manages the DIVEN MAIN CP and coordinates the efforts of the staff (both officers and noncommissioned officers) during the military decision-making process (MDMP). Soldiers from the S2 and S3 staff sections operate the DIVEN MAIN CP. When conducting the MDMP, the XO includes the S1, the S4, liaison officers, and others in the effort.

At the DIVEN MAIN CP, the S2 and S3 receive reports, develop the situation, and attempt to answer the commander's critical information requirements (CCIR). The staff assembles, packages, and forwards answers to CCIR and other information to engineer C2 nodes. The CCIR form, in part, a filter to screen which information is sent to other C2 nodes, and successful units establish the mechanics of this effort in their SOP. For example, a unit may describe the best way to package CCIR information for the tactical CP engineer. In this way, the DIVEN MAIN CP—

- Maximizes the available staff effort and expertise to collect, analyze, and disseminate information.
- Ties information collection and dissemination to the CCIR.
- Streamlines routine, cyclic reporting requirements for subordinate engineer units.
- Functions as the nucleus of engineer C2 functions in the division.

The Division Engineer Rear CP

Within the division rear CP, the engineer S4 is the officer in charge of the DIVEN REAR CP. The S4 integrates engineer operations among other division logisticians. The S4 understands that main supply routes must remain clear of obstacles, that defensive operations require early planning and transport of Class IV/V obstacle materiel, and so on.

The DIVEN REAR CP requires the same situational awareness as the DIVEN MAIN CP for several reasons. The S4 requires current information so that the DIVEN REAR CP can effectively integrate engineer operations into division plans. Also, the DIVEN REAR CP must be prepared to assume the duties of the DIVEN MAIN CP. And, since the engineer XO assesses the logistics supportability of engineer plans based on the S4's staff estimate, it is essential that the S4's estimate is based on current information.

Accordingly, the DIVEN REAR CP duplicates the battle tracking conducted in the DIVEN MAIN CP. Because staffing at the DIVEN REAR CP often is limited, the integration function of the S4 eventually overtakes the battle-tracking function. When this occurs, the S4 loses situational awareness and the DIVEN REAR CP's plans no longer synchronize with the true picture of the mobility/survivability BOS. The S4's time is best spent integrating engineer operations across the division logistic framework rather than collecting and posting information.

A TTP some units use to maximize the integration function of the DIVEN REAR CP is to proactively "push" information to the DIVEN REAR CP from the DIVEN MAIN CP. Details about which information the DIVEN REAR CP requires and how to package that information are established in the SOP. In some units, the division engineer, the XO, and/or the command sergeant major provide a structured update to their staffs whenever they visit an engineer C2 node. This practice can have a marked positive effect on the situational awareness and battle-tracking accuracy of engineer CPs. To assist in achieving this common picture, the battle-tracking charts at the DIVEN MAIN and REAR CPs are identical.

The Assistant Division Engineer

The assistant division engineer (ADE) is the division engineer's primary point of contact regarding division plans and current operations cells in the division main CP. The ADE plans future engineer operations and often integrates mobility and survivability issues in the division deep operations coordination cell. An effective TTP to maximize the ADE's integration and planning functions is to push critical information to the ADE on the same basis as information flows to the DIVEN REAR CP.

Most units recognize that the ADE cannot perform planning and battle-tracking functions simultaneously. Accordingly, they limit the ADE's duties to planning. In some units the engineer XO, rather than the ADE, is responsible for briefing the division commander during his morning update brief. This frees the ADE to continue planning and provides him with "ground truth" as the DIVEN MAIN CP, through the XO, understands it. The XO pushes information to the ADE throughout the MDMP. This practice allows parallel planning and helps to ensure that the ADE and DIVEN MAIN CP have a common understanding of the enemy, the terrain, and friendly engineers.

It is imperative, however, that the DIVEN MAIN CP pass along only *critical* information. The ADE, like the S4, is not staffed to wade through unit status and logistics reports or dozens of electronic mail messages. Here, as with other engineer C2 nodes, experience and attention to the CCIR help define what the ADE needs to know. What information is important will vary based on the tactical situation and the commander's needs.

The Division Engineer Tactical CP

Most divisions establish a TAC CP as a matter of course. Engineers staff the DIVEN TAC CP within the TAC CP. In some units the engineer S3 works from this CP all of the time. In other units he remains in the DIVEN MAIN CP and assists at the TAC CP during major operations. In either case, the function of the TAC CP is to *fight the close battle.*

According to FM 5-71-100, forward engineer units report directly to the DIVEN TAC CP during the close fight. Action in the TAC CP is fast-paced, and the S3 quickly develops a sense for what information he needs to synchronize these engineers. Information requirements for the DIVEN TAC CP typically are smaller than those for the other engineer C2 nodes. For example, during offensive operations the S3 may only require the location of friendly engineer units; the status of sapper squads, mine-clearing line charge systems, and bridging assets; and the location and type of friendly and enemy obstacles. In some units this information is known as a "slant report." The point is that the S3 must carefully craft the information the TAC CP requires and let the DIVEN MAIN CP process the rest.

Forward units continue to send *routine* information to the DIVEN MAIN CP. Again, the DIVEN MAIN CP pushes information to the DIVEN TAC CP to assist the S3 in fighting the close battle. The S3 and the XO develop the list of information requirements for the DIVEN TAC CP based on the CCIR, and package it in a form that is immediately usable by TAC CP personnel.

As the Army shifts to the new heavy division design and as more information automation equipment finds its way into command posts, the functions of the divisional engineer C2 nodes will evolve. The DIVEN MAIN CP currently is the most robust of these C2 nodes in terms of both manning level and experience. Units that rely on the DIVEN MAIN CP to collect, analyze, and disseminate information enable the other C2 nodes to focus on their primary mission, whether that is to plan future engineer operations, integrate engineer plans into the combat service support structure, or track the close fight. Units that rely on the DIVEN MAIN CP to be the nucleus of the engineer C2 function realize increased synchronization and more effective utilization of engineers across the division.

Lieutenant Colonel Light is an observer/controller for the Battle Command Training Program at Fort Leavenworth, Kansas. He previously served as the S3 and XO of the 168th Engineer Battalion, 3rd Brigade, 2d Infantry Division, Fort Lewis, Washington.

Training Base Expansion: An Active-Reserve Partnership

By Lieutenant Colonel Allen C. Estes and Second Lieutenant Kenneth Caubble

Training units at Fort Leonard Wood experience a surge of trainees each summer that stretches and sometimes exceeds the resources available in the authorized training base. The solution has been a training base expansion (TBE) mission where U.S. Army Reserve soldiers from the 98th Division (Institutional Training) stationed throughout New York state provide the additional capacity. The relationship between Fort Leonard Wood and the 98th Division is one of the best active-reserve partnerships in the Army. Both sides win. The Active Component is augmented during the summer surge, and the Reserve Component receives a top-notch, two-week annual training experience. Their combined efforts result in the Army's newest soldiers.

Organization

Rather than augment existing companies with more drill sergeants, the training battalion activates an additional company for the TBE period. The 98th Division provides enough cadre for a complete training company, which includes a commander, an executive officer, a first sergeant, 12 drill sergeants, a supply sergeant, an operations sergeant, and an armorer. The entire cadre rotates every two weeks. To provide continuity and stability, the activated TBE company has a mix of active and reserve cadre members.

Figure 1 shows the typical TBE company organization, where the 98th Division provides the commander, the first sergeant, and half of the drill sergeants. The Active Component provides the executive officer and the other half of the drill sergeants, including the senior drill sergeant, who coordinates most of the training. The company staff (operations, supply, and armorer) are a mix of Active and Reserve Component personnel. Meanwhile, the rest of the reserve cadre backfills existing companies. For example, if the active executive officer for the TBE company is from Charlie Company, then the reserve executive officer backfills the vacant spot. Each company in the battalion has Reserve Component personnel assigned during the TBE mission.

Fort Leonard Wood's 169th Engineer Battalion (One-Station Unit Training [OSUT]), for example, recently formed an Echo Company, which was led by company commanders from the 1/390 and 2/390th Battalions from the 2nd Brigade, 98th Division. Echo Company was activated on 27 April 1998, executed a complete 13-week cycle of OSUT for 12B

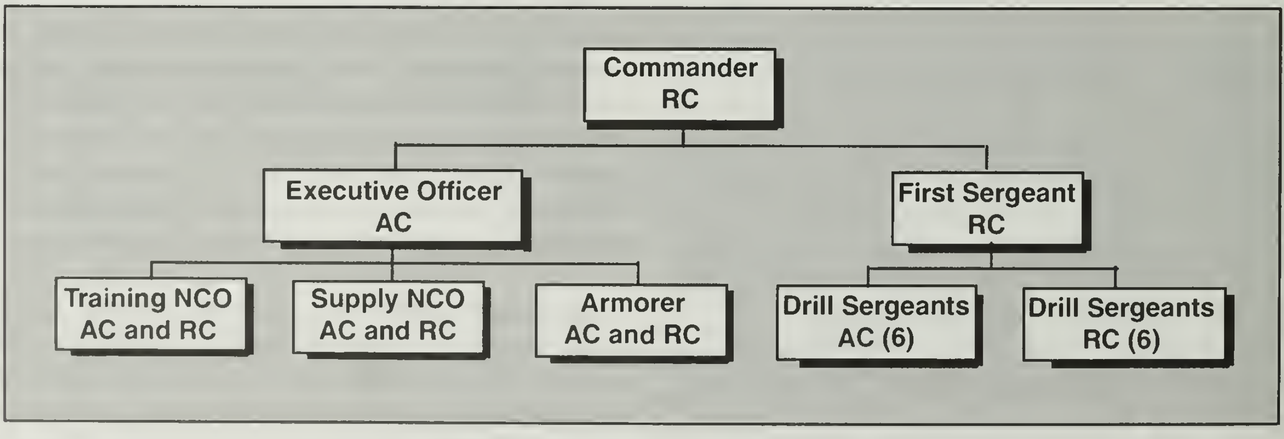


Figure 1. Organization of the TBE company

OSUT trainees negotiate obstacles on the Confidence Course

Combat Engineers and 12C Bridge Crewmembers, and was inactivated on 31 July. The mission included eight separate cadre increments, or rotations, over 16 weeks. Figure 2 shows the role of each increment.

Coordination

The TBE executive officer and senior drill sergeant are critical members of the team since planning must extend past the two-week rotations. Coordination and arrangements for field training exercises (FTXs) and graduation are completed six to eight weeks in advance. Using some Active Component personnel in the TBE company provides continuity and allows trainees to see some of the same faces throughout the entire cycle. The TBE company conducts the same training to the same rigorous standards as any other OSUT company. The reserve drill sergeants are partners and participate fully—they teach classes, counsel soldiers, run ranges, and perform such mundane details as KP (kitchen police) and CQ (charge of quarters).

There is a one-day overlap between rotations. During that transition period, incoming and outgoing cadre share information, sign over equipment, and conduct a formal but quick change of command. The outgoing rotation conducts an after-action review with the battalion commander and turns over the continuity book. The incoming rotation receives a legal orientation, safety classes, and commander briefings. Meanwhile, soldier training does not cease or even slow down. To ease the transition, reserve soldiers arrive with their driver's licenses, defensive driving course cards, range safety cards, and updated training records.

Preparation

The TBE mission requires significant preparation from both the Active and Reserve Components. The 98th Division prepares extensively throughout the year with

Increment	Week	Activity
1	1 2	Activation ceremony, mission preparation Company fill
2	3 4	Unit-taught subjects, drill and ceremony, Army Physical Fitness Test First aid, map reading, NBC
3	5 6	Rifle marksmanship, weaponeer, zeroing, field fire Rifle qualification, U.S. weapons, hand grenades
4	7 8	Basic FTX, individual tactics, night ranges Confidence Course, bayonet training, hand-to-hand combat
5	9 10	End-of-Course Test, drill and ceremonies competition, basic graduation Demolitions, accident avoidance, combat construction
6	11 12	Landmine warfare, medium-girder bridge, battle drills Bailey bridge and armored vehicle-launched bridge training
7	13 14	Ribbon bridge and armored combat earthmover training Combat engineer FTX, End-of-Course Comprehensive Test
8	15 16	Final inspection, out processing, graduation Inactivation ceremony, closeout procedures

Figure 2. Schedule of TBE increments for a 12B/12C OSUT cycle

weapons qualification; nuclear, biological, and chemical (NBC) training; drill and ceremonies; common task training; field training exercises; physical training; and instruction preparation. The 169th Engineer Battalion and the 98th Division coordinate year-round. As the mission approaches, the 169th sends a mobile training team to New York to answer questions and address specific training needs. This allows face-to-face contact with team members, most of whom have never met. Given the Active Component turnover, it is difficult to use the same experienced personnel from year to year. However, many of the reserve drill sergeants have been coming to Fort Leonard Wood for more than a decade.

The reserve company commander for the first TBE increment goes to Fort Leonard Wood for the cycle laydown. At that time, training events are scheduled, resources are allocated, and training areas are assigned. Once the TBE laydown is complete—along with laydowns for companies that will be backfilled—reserve drill sergeants know which training will take place during their two-week rotation, and they can prepare in detail.

Meanwhile, Echo Company cadre at Fort Leonard Wood prepare the orderly room, purchase supplies, establish accounts, and prepare barracks for the new company. The 98th Division sends a series of S3 liaison officers and noncommissioned officers before activation to help prepare for a successful mission. The 169th and the 98th Division conduct weekly conference calls to coordinate details and provide information for upcoming increments.

The TBE mission culminates with the graduation of the OSUT cycle of trainees, where a motivated and disciplined group of 12B and 12C soldiers are ready to make an immediate contribution to their Army units. The final increment closes the orderly room and billets, replenishes supplies, conducts the inactivation ceremony, and makes initial preparations for next year's mission. After-action comments are compiled and the 98th Division hosts a conference in New York, where all participants discuss lessons learned and suggest procedures to improve the next mission.

Lessons Learned

Key lessons learned from the recent TBE mission follow:

- Coordination among first sergeants on barracks rules, policies, and areas of responsibility is key to success. The TBE company rarely has its own barrack since it would be vacant nine months of the year. If an Active Component company has a small fill of soldiers, that company shares its barrack with the TBE company. If all companies have large classes in session, the TBE company splits and one platoon occupies each of the barracks.
- The 98th Division liaison officer must arrive well before the mission begins. He opens accounts, arranges billeting, coordinates transportation, and ensures that each increment of TBE cadre receives logistical support. The division liaison officer is one of the most important individuals in the entire mission.
- Reserve drill sergeants must do everything expected of active drill sergeants so the two will be viewed as equal in the eyes of trainees. Reserve drill sergeants should pull their fair share of duties but no more. A successful technique is to put TBE drill-sergeant slots on DA Form 6 (Duty Roster) and rotate each increment into those spaces. During physical training, the 1st Engineer Brigade wears specially purchased red road-guard vests with white name tags. The brigade purchased vests for TBE cadre and had name tags made and sewn on before the cadre arrived. Any action that makes the reserve cadre indistinguishable from the active cadre pays big dividends.

Conclusion

The TBE mission can only succeed through teamwork and frequent communication. Reserve Component soldiers must coordinate with their civilian supervisors to attend annual training. Active Component personnel must provide accurate and timely information on the training cycle. There are many moving pieces and lots of opportunities for error. The TBE works because of a spirit of cooperation and constant coordination. The training base expansion is an ideal example of how the Active and Reserve Components can work as equal partners to perform a difficult mission.

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Lieutenant Caubble is executive officer of C Company, 169th Engineer Battalion, and serves as executive officer of the TBE company. He is a graduate of the Engineer Officer Basic Course and holds a degree in civil engineering from Arkansas State University.

CRACKING THE CODE ON CLASS IV/CLASS V SUPPLY POINT OPERATIONS

By Captain Mark T. Martinez

Cracking the code on how to plan and conduct Class IV/Class V supply point operations on the battlefield can be painful and, if not done correctly, can cause a lot of finger pointing during after-action reviews (AARs). A challenge for any brigade is to develop a standing operating procedure (SOP) for running a Class IV/Class V supply point, identify those responsible for planning and running it (called "pinning-the-rose"), and train those individuals with the rest of the brigade according to the SOP. This article describes how the 3rd Brigade Combat Team (3BCT), 1st Armored Division, Fort Riley, Kansas, cracked this code during their train-up for, and deployment to, the National Training Center for Rotation 98-08.

Doctrine Guidance

What was once known as the engineer forward supply point (run by an overworked, sleep-deprived engineer assault and obstacle platoon leader) is now the task force Class IV/Class V supply point. It is run by the maneuver S4. According to guidance in FM 90-7, *Combined Arms Obstacle Integration*, page C-9, this central receiving point for all obstacle material in the task force sector is established and operated by the task force, not the engineers.

"Pinning the rose" on the task force S4 is sometimes difficult. He is not trained for this task, and his chain of command may view Class IV/Class V operations as an engineer's job. When the task force pawns this task off on its organic engineers, it degrades engineer capabilities on the ground. We must educate our maneuver brethren to correctly use their engineer assets by taking ownership of the Class IV/Class V supply point.

Make It Simple

The first thing engineers must do to educate the brigade's maneuver personnel is to condense complex information in field manuals and all of the algebraic planning factors into easily understood and executable concepts. The 3BCT uses acronyms (Figure 1) to simplify these planning factors and PowerPoint slides to present them.

Simple to Plan

In the 3BCT, each task force S4 and XO is given what the engineers call a "WELCOMES" card that outlines planning considerations a task force S4 must observe to conduct a successful Class IV/Class V supply point. The acronym "WELCOMES" means the following:

W = Work Detail. The 3BCT SOP calls for one noncommissioned officer in charge (NCOIC) and 20 soldiers to form a work detail. The NCO is not an engineer and usually is from the task force S4 shop. The 20 soldiers make up three crews. The unloading crew downloads wire and mines from Corps throughput assets, and the uncrating crew uncrates mines, inspects them, and configures them into push packages. The loading crew then loads the push packages onto task force transportation assets for transport to forward mine dumps.

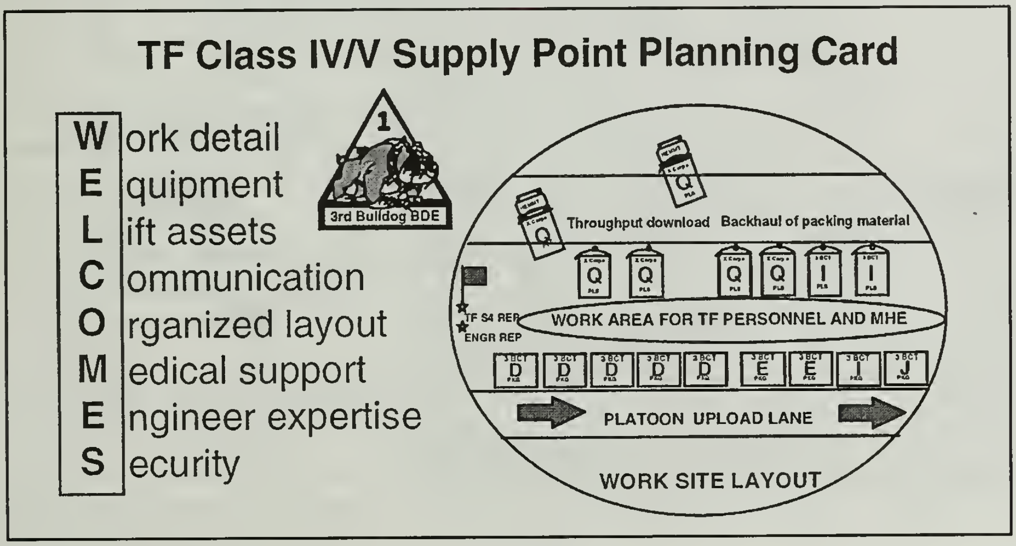


Figure 1

"Planning and running a Class IV/Class V supply point is like having a tooth pulled—no matter how many times you do it, it's still not much fun."
A task force S4

AAR Comment. Use the task force's heavy expanded mobility tactical vehicle (HEMMT) to transport push packages.

E = Equipment. Equipment required to run the supply point includes wire gauntlets for each soldier, banding machines, tin snips, crowbars, and engineer tape. Material required to lay out the site includes bicycle flags or a hand-emplaced minefield-marking set, engineer tape, green and red chemlights, and a picket pounder (Figure 2) A warm-up or sleep tent also may be needed.

AAR Comment. Each TF S4 shop should maintain a footlocker with this necessary equipment that can be easily transported to the Class IV/Class V supply point site.

L = Lift Assets. According to the 3BCT SOP, the task force S4 requests materiel-handling equipment (MHE) and additional transportation assets from the forward support battalion's support operations officer. The Class IV/Class V supply point belonging to the task force responsible for the main effort has priority for receiving lift assets.

AAR Comment. During the planning process, units should war-game and "rock drill" moving the MHE to the Class IV/Class V supply point. Ensure that the forklift operator is equipped with night-vision goggles for night operations.

C = Communications. The task force S4 maintains communications with the task force tactical operations center (TOC). The engineer representative at the Class IV/ Class V supply point maintains communications with engineer platoons and the engineer company TOC. The engineer company TOC maintains communications with the engineer S4 on the engineer battalion administrative/logistic (A/L) net. This communication web is driven by the unit's signal plan and varies with each unit.

AAR Comment. A good retransmission plan for the battalion A/L net is essential for this to work.

O = Organized Layout. The 3BCT uses the palletized load system to deliver Class IV/Class V supplies. A standard layout was developed to give the task force S4 a baseline for using this system effectively (Figure 2). During the National Training Center rotation, each task force S4 revised the standard layout according to the mission, enemy, terrain, troops, and time available (METT-T).

AAR Comment. Mark this layout clearly before night operations, because vehicles that wander into the work area after dark pose a serious safety threat to personnel.

M = Medical Support. The task force S4 must coordinate for medical support and develop an evacuation plan. The task force Class IV/Class V supply point NCOIC maintains a list of trained combat lifesavers in each work group and the battle roster of all personnel at the supply point.

AAR Comment. The medical support plan must be synchronized with the task force scheme of support for that phase of the operation.

E = Engineer Expertise. Each engineer company supporting the task force in sector provides an engineer NCO representative to the task force S4. This NCO is not the supply

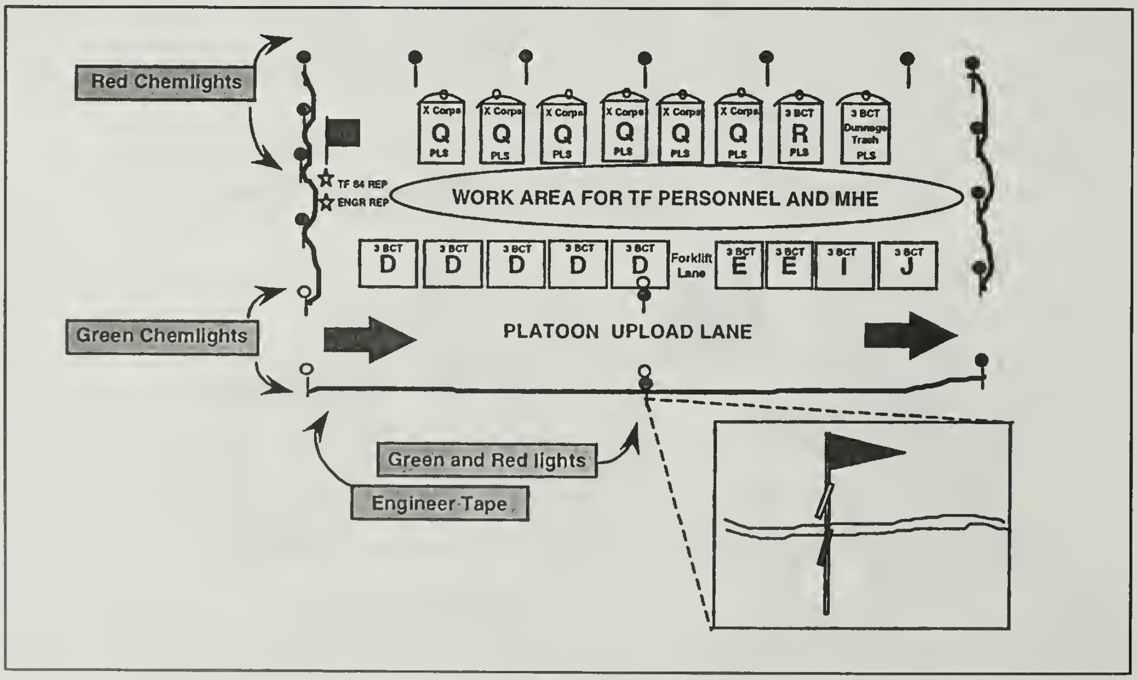


Figure 2

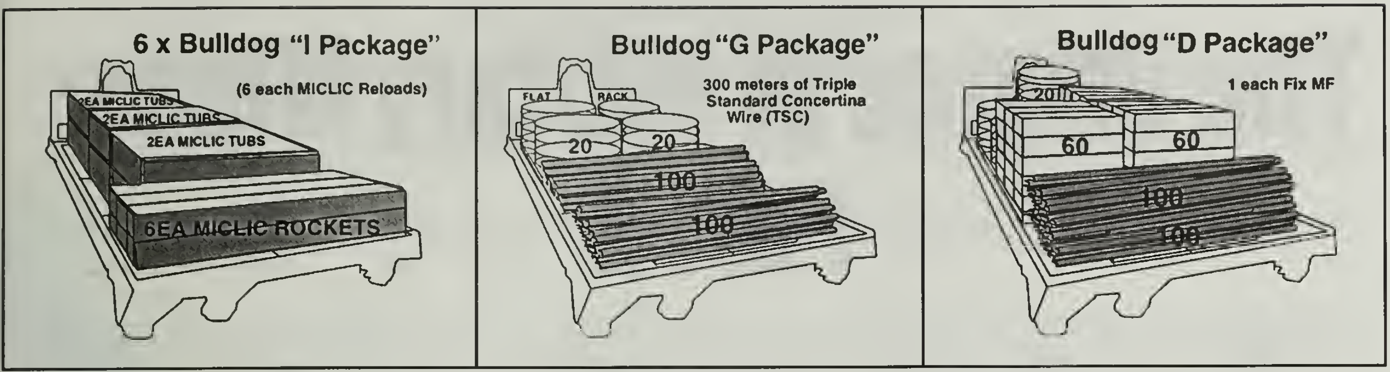


Figure 3

point NCOIC and does not supervise the work detail. He provides technical expertise for the push-package configuration; oversees the handling of mines, fuses, and antihandling devices; and monitors and records the quantities of Class IV/Class V supplies at the site.

AAR Comment. Use the same NCOIC each time, so he will build a good working relationship with the task force S4.

S = Security. The task force S4 and staff, in cooperation with the engineers, selects a Class IV/Class V supply point location that can be easily defended against both mounted and dismounted troops. The S4 develops and enforces the site security plan. The task force provides a security force for the supply point.

AAR Comment. This task often is given only "lip service." The task force must initiate a security plan. Losing the Class IV/Class V supply point to "dismounts" has grave consequences.

Simple to Run

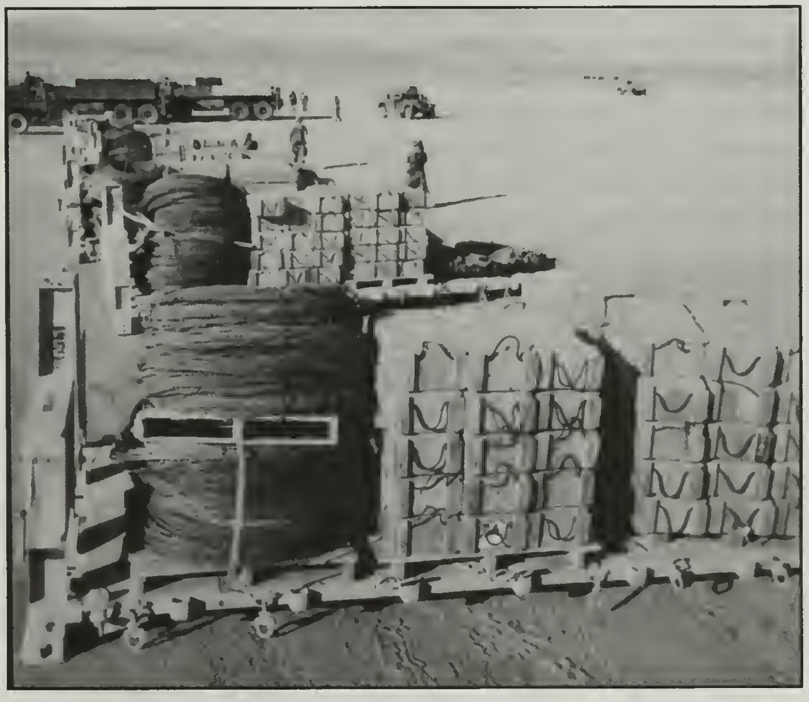
A plan is only good until the line of departure, so keep it as simple as possible. FM 90-7, page 8-9, states that most brigades and regiments in the U.S. Army use push packages to simplify and expedite planning and resourcing of Class IV/Class V supply points. Push packages are the most efficient way to get the right amount of wire and mines to the right spot on the battlefield, especially when you are 72 hours into your failed sleep plan.

The 3BCT takes the push-package concept one step further and provides the task force S4s with a "cookbook" that describes the push packages (Figure 3) Each page shows a picture of the material required for a particular type of obstacle. To facilitate building and transporting, the page also shows how the material is arranged on the palletized load system flatrack. At the National Training Center, this cookbook was extremely helpful in recovering and reconfiguring push packages so they could be used again in the next fight. For example, the task force S4 used the cookbook to provide a picture of the "G Package" to the supply point NCOIC and asked him to build a number of them. In this case, one picture is worth a thousand directives.

Sustain the Fight

The Class IV/Class V supply point plays a key role in sustaining the fight. This fact sometimes is overlooked until the call comes to end the mission, and then it becomes a reaction drill to recover lost barrier material. An easy way to plan recovery operations is to use the four "Rs": retrieve, reconsolidate, reconfigure, and reintroduce When transitioning from the defense, the implied task for the task force can be: "Conduct battlefield recovery operations using a collective effort to retrieve, reconsolidate, reconfigure, and reintroduce Class IV/Class V supplies into the battle." To recover obstacle effects, reconfigure the packages, and reintroduce them into the fight is essential in conducting sustained defensive operations. The Class IV/Class V supply point should be the cornerstone for this operation, and the task force S4 must be trained in recovery operations.

(Continued on page 50)



Push packages loaded with obstacle material.

The Origins of Military Mines: Part II

By Major William C. Schneck

Part II of this series traces the origins of antivehicle mines and countermine equipment. Though it may seem odd, the explosive antivehicle mine predates the appearance of the tank by more than 50 years! The continuous evolution of these weapons is driven by the defender's need to economize his forces while protecting them from attack. This, in turn, drives the development of the countermine equipment that attackers must have to successfully retain their mobility.

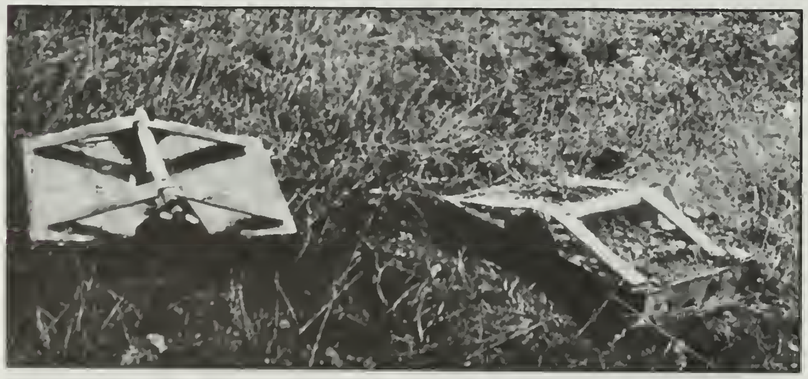
Antivehicle Mines

One of the earliest antivehicle "mines" was described by military engineer Philo of Byzantium around 120 B.C., when he recommended that "in front of the advanced walls (of a city) empty earthenware jars should be buried. These are placed in an upright position with their mouths upward, stopped up with seaweed or imperishable grass, and covered with earth. Troops may then pass over the jars with impunity, (but) the engines and timber towers brought up by the enemy will sink into them."[1] Another early example occurred during the Roman siege of Jerusalem in 70 A.D., when Jewish Zealots dug a tunnel mine under one of the besieger's four massive siege engines (powerful battering rams on wheels), resulting in its destruction and a three-day delay in the battle.[2] During the American Civil War, Confederate soldiers developed and employed pressure-fuzed railroad mines that destroyed at least two heavily loaded trains in Tennessee.[3] To counteract the railroad mines, the Union Army improvised the first mine-clearing roller, a flatcar pushed slowly in front of a locomotive to detonate any mines ahead of it.[4]

Antitrack (Pressure-Fuzed) Mines

German pioniere (combat engineers) improvised the first antitank (AT) mines during World War I in response to another innovation in combat engineering—a British-made tank developed in September 1916 by Lieutenant Colonel E. D. Swinton, Royal Engineers (RE). Initially, the Germans buried standard artillery and mortar shells with a sensitive fuze pointed up. They also employed command-detonated mines, which are forerunners of full-width-attack AT mines. Later in World War I, the Germans improvised many types of mines, including a wooden box mine that measured approximately 14 by 16 by 2 inches and weighed about 12 pounds. Twenty 200-gram blocks of explosive were placed in each box, which was normally buried about 10 inches deep. Detonation was initiated by a hand grenade placed inside and against one wall of the box so that the primer passed through the wall. The mines functioned by pressure as tanks passed over them or by command detonation. Electric blasting caps, which first appeared in 1900, greatly facilitated command detonation.[5] During World War I, Germans scattered their AT mines at random or in locally created patterns to reinforce wire obstacles and AT ditches in front of trench lines.[6]

The Germans began to manufacture standard AT mines in 1916 and produced nearly three million before the Armistice of 1918. Regrettably, no information on the characteristics of these factory-produced mines has come to light. German AT mines accounted for a significant portion of allied tank losses, including about 15 percent of U.S. tank casualties, during the battles of St. Mihiel, Catalet-Bony, Selle, and Meuse/Argonne.[7] The British also improvised AT mines during World War I. Two varieties have been identified: one based on a pipe bomb and the other on a bombard shell.[8] In 1929, the Germans introduced the Tellermine 29, the first in a series of modern pressure-fuzed AT mines. This series formed the basis for many of the AT mines used to date, including the U.S. M15.



A German World War I vintage antitank mine lifted by U.S. combat engineers prior to its destruction. (Photo courtesy of *Military Engineer* magazine)

Table 1. Origin of Mobility Equipment

Equipment	First Prototype	First Production	First Combat Use
Bangalore torpedo	U.K., 1912		U.K., Western Front, WWI
Tank mine roller	U.K., 1918	U.S.S.R.	U.S.S.R.,
Tank mine plow	France	U.K.	U.K, Sword Beach, WWII
Electronic mine detector	France		Germany, Polish Campaign, 1939
Vehicle-mounted electronic mine detector	France, Pre-WWII	U.S.	U.S.
Flail	U.K., 1942	U.K., 1943	U.K., 2d El Alamein, 1942 (24 prototypes were used in this battle.)
Remote-control breaching	France	Germany, 1940	Germany, Sevastopol, 1942
Demolition snake	Canada		U.S., Anzio, May 1944
Projected line charge	U.K., 1944	U.K., 1944	U.K., Calais, September 1944
Mine-resistant wheeled vehicle	U.K., 1941	Sweden, 1940s	U.K., North Africa, 1941
Scatterable mine-clearing system	France, 1980s	Israel	
Full-width mine rake	U.S., 1990	U.S., 1990	U.S., Gulf War, 1991

Antihull (Full-Width-Attack) Mines

The Russian AKS, a tilt-rod-actuated blast AT mine that appeared on the Russian front during World War II, was probably the first true full-width AT mine. However, the Germans developed the first modern full-width-attack mine toward the end of World War II. Called the Hohl-Sprung Mine 4672, it employed a tilt-rod fuze and shaped-charge kill mechanism.[9] Although 59,000 of this mine were produced, there are no reports that it was ever used in combat.[10] Nevertheless, it represented a significant improvement in mine technology. The French probably were first to field a modern full-width-attack mine when the Model 1948 entered service in 1948.

Another important advance in the evolution of the full-width AT mine was the Russian development of influence fuzing, both seismic (VZ-1) and magnetic, during World War II.[11] This combination of a shaped charge with a full-width-attack fuze has proven extremely effective. Its greater coverage enables emplacing units to get the same obstacle effect with significantly fewer mines per kilometer of front. Additionally, this type of mine often produces a K-kill (catastrophic kill), with fatalities to crew members of all vehicles, including tanks and other tracked vehicles. This lethality definitely decreases the willingness of combat vehicle crews to "bull through" a mined area.

Side-Attack Mines. The advent of shoulder-fired AT weapons, beginning with the U.S. bazooka in 1942, led to the development of side-attack AT mines. First employed by the Germans and Soviets during World War II, these mines were based on the Panzerfaust.[12] The early Soviet-made LMG reportedly is still being used by North Korea.[13] This type of mine is difficult to employ due to its large size and because it must be emplaced aboveground.

Wide-Area Mines. The predecessor of the wide-area landmine—one that sends a munition toward its target without human guidance—is the Russian "dog mine" of World War II.[14] Advanced wide-area mines are now emerging in Western Europe and the United States.[15]

Mine-Emplacement Systems

The Italian AR-4 Thermos Bomb (also called Antipersonnel (AP) Bomb Manzolini) was one of the first scatterable mine-laying systems used in combat. Scattered by aircraft, it was used fairly extensively in North Africa from 1940 to 1942).[16] Another early scatterable mine was the German SD-2B Schmetterling (butterfly). It was used effectively against the Poles in September 1939. Both types employed antidisturbance and time-delay fuzing. The Germans also developed a cluster-bomb version of the SD-2 that had airburst or impact fuzing. An aircraft-dropped bomb container could carry 24 Thermos bombs as a submunition. The Schmetterling could be carried as submunitions in the following cluster-bomb containers: AB 23 (23 SD-2s), the AB 250-3 (108 SD-2s), the Mk 500 (6 SD-2s), and the AB 24t (24 SD-2s),[17] In addition to Poland, the Schmetterling was used in France, North Africa, Italy, England, and Russia.[18] It could be dropped by one of 15 Luftwaffe groups equipped with specially modified aircraft (Ju-88s, Do-17s, Me-109s, or Ju-87s).[19] The U.S. Air Force copied this mine, called it the M-83, and used it against Germany and later in Korea[20] and Vietnam.[21] In Germany, Krupp developed (but did not field) the first mechanical mine planter, which was towed behind a Tiger tank.[22] The U.S. Marine Corps developed the first air-scatterable AT mine—the Douglas Model 31 from 1952 to 1958. The first one to enter production (in 1975) appears to be the U.S.-made UH-1 helicopter-mounted M-56 system, which used the M-34 AT mine.[23]

Table 2. Origin of Countermobility Equipment

Mine/Fuze Type	First Prototype	First Production	First Combat Use
Tunnel mining			Assyria, ~1000 BC
Caltrops			Greece, 330 BC
Explosive tunnel mines			Florence, 1403
Self-contained AP mine	China, 1277	China, 1277	China, 1277
Electric command- detonated mine	France, 1858		France, Sevastopol, 1858
Blast AT Mine	Germany, 1917	Germany, 1918	Germany, Western Front, 1917
Bounding AP mine	U.S., 1859	Germany, 1930s	Germany, West Wall, 1939
Chemical mine	U.K.	Germany, WWII	
Flame mine	Confederacy, 1864[1]	U.S.S.R., 1943	U.S.S.R., Kursk, 1943
Mechanical boobytraps	China, 1277	Confederacy, 1864[1]	China, 1277
Side-attack AT mine	Germany, 1943	U.S.S.R., 1943	Germany, Eastern Front, 1943
Full-width-attack AT mine	Germany, 1945	France, 1948	
Fixed-wing aircraft- scattered AP mine	Germany, 1930s	Germany, 1930s	Germany, Polish Campaign, 1939
Fixed-wing aircraft- scattered AT mine	U.S.	U.S., 1960s	U.S., Southeast Asia, 1960s
Helicopter-scattered AP mine	U.S., Vietnam	U.S.S.R., 1970s	U.S.S.R., Afghanistan, 1980s
Helicopter-scattered AT mine	U.S., 1970s	U.S., 1975	USSR, Afghanistan, 1980s
Tube artillery-scattered mines	U.S., 1970s	U.S., 1970s	U.S., Gulf War, 1991
Rocket artillery-scattered mines	U.S.S.R., 1970s		U.S.S.R., Afghanistan, 1980s
Vehicle-scattered mines		U.S., 1970s	
Manpack-scattered mines		U.S., 1990s	
Radio-controlled mines		U.S.S.R., 1941	U.S.S.R., 1942
Tilt-rod fuze		U.S.S.R., 1941	U.S.S.R., 1941
Daisy-chained mines	Finland, 1939		Finland, 1939
Coupled mines	Germany, 1942	Germany, WWII	Germany, North Africa, 1942
Boosted mines	Germany, 1942		Germany, North Africa, 1942
Breakwire fuze		U.S., 1960s	U.S.S.R., Afghanistan
Tripwire fuze	Germany, 1573	Germany, 1939	Germany, 1500s (?)
Railroad mine	Confederacy, 1862[1]	Germany, WWII	Confederacy, Civil War, 1862[1]
Electronic boobytrap		Yugoslavia, 1980s	Yugoslavia, 1990s
Low-metal mine		Finland, 1939	Finland , 1939
Influence fuze		U.S.S.R., WWII	U.S.S.R., WWII
Antihandling devices		Germany, 1930s	Germany, WWII
Mechanical mine planter	Germany, WWII	U.S.S.R., post-WWII	
Blast-hardened mines		Italy, 1980s	Mujahideen, Afghanistan, 1980s
Antihelicopter mine	Viet Cong, Vietnam War		Viet Cong, Vietnam War
Integral electronic antihandling device		Italy, 1980	

[1] Confederate States of America, 1861-65.

Countermines

The original countermines were tunnels dug by besieged defenders to disrupt enemy mining efforts. A countermine was successful when an enemy tunnel was intercepted. Inevitably, a confused, close-quarters fight in the dark followed, as the two sides fought to control the tunnel.[24] One example of this occurred during the siege of Barca about 510 B.C. "The Persians excavated underground tunnels that reached the walls. Among the Barcaeans there was a skilled worker in brass who took a brazen shield and, carrying it round within the wall, applied it here and there at places where he thought the workings might be. Where there were no mines the shield was silent, but at places near mining operations the shield made a vibrating sound. By countermining at these points, the Barcaeans broke into the enemy's works and slew the men they found there."[25]

Explosive Countermines. The first identified use of an explosive countermine was during the siege of Belgrade in 1433, when John Vrano used black powder in a countermine against the Turks.[26] In this application, the intent was to dig close to the enemy's mine gallery and emplace and detonate a charge that would collapse the tunnel and kill the miners. This type of explosive countermine was used up to World War I.[27] During the Thirty Years War in central Europe (1618-1648), some defenders released poisonous antimony gas into tunnels to kill miners.[28]

Manual Breaching. The first deliberate breach of a minefield was by Colonel Serrel's 1st New York Volunteer Engineers at Fort Wagner, South Carolina, in August and September 1863 during the Civil War. Union sappers literally dug their way through the minefield using traditional siege warfare techniques.[29]

Mine Plows, Rakes, and Detectors. In 1918, the French developed the first plow-equipped tank, which was based on a Renault FT-17 tank.[30] However, plow tanks were not used in combat until D-Day in 1944, when the British 79th Armored Division employed a "Bullshorn" plow on a Churchill tank at Sword Beach.[31] Modern versions used by most countries, including the United States, are based on an Israeli design. The highly successful full-width mine rake was first developed and used by the United States during Operation Desert Storm.

The Germans, French, Russians, and Italians entered World War II with metallic mine detectors, but information on the details of their origin is lacking.[32] During the interwar years, the French developed the first vehicle-mounted electronic mine detector on an R-35 tank.[33]

Bangalore Torpedo. Captain McClintock—an engineer officer in the Bengal, Bombay, and Madras Sappers and Miners—invented the bangalore torpedo in 1912. Its purpose was to counter problems caused by the rise of barbed-wire obstacles during the Boer War (1899-1902) and the Russo-Japanese War (1904-1905). The torpedo, which took its name from Bangalore, India, where it was developed, was originally a 5.5-meter length of pipe filled with 27.2 kilograms of dynamite.[34] Early in World War II, the torpedo was found to effectively clear a path through minefields, and it remains a standard item in most armies. In 1944, the United States began experimentation for a supplemental system that would use a bullet-trap rifle grenade or small rocket to deploy a length of detonating cord,[35] but these devices have not been generally accepted. A more likely successor is the U.S. Antipersonnel Obstacle-Breaching System (APOBS), which is based on the Israeli-developed POMINS.[36]

Mine Rollers and Assault Bridges. At the end of World War I, the British developed a tank-mounted mine roller as a countermeasure against German AT mines. Major Martel (RE) explored the possibility of producing mine rollers and assault bridges that could be used by armored vehicles. Martel was assisted by Major Inglis from the Engineer-in-Chief's branch at general headquarters. Inglis, an engineering professor at Cambridge, had designed a prefabricated tubular mobile bridge to carry tanks across a clear span of 100 feet. Three special tank battalions, one commanded by Martel, were formed at Christchurch in Hampshire, England, in 1918. Each battalion had Mk V tanks designed to accept either mine rollers or to push/pull mobile bridges. Although the armistice came before the units were operational, Martel continued trials with the one remaining unit, called the Experimental Bridging Company, which was transitioned to the civilian-controlled Experimental Bridging Establishment in 1925.[37] The mine roller was first used in combat in 1940, when the Russians used it to help breach Finland's Mannerheim Line.[38] The highly successful Russian Mugalev roller, which first saw action in 1942, was developed based on this experience.[39] Most rollers currently used by former Warsaw Pact countries, Israel, and the United States are patterned after the Mugalev roller.[40]

Snake. The demolition "Snake" was first developed by Major MacLean, a Canadian combat engineer from the 11th Field Company, in October 1941. Originally nicknamed the "Worthington Wiggler" after F. F. Worthington, commander of the 1st Canadian Tank Brigade, it was basically an oversized bangalore torpedo. The Snake consisted of sections of 3-inch diameter pipe loaded with explosives, which could be coupled together in lengths up to 400 feet and pushed as a unit across a minefield ahead of a tank. The subsequent detonation would clear a path through the field. The Snake was demonstrated successfully in February and March 1942.[41] Although the U.S. Army was equipped with a small number of them during the campaign in North Africa, the Snake was first used in combat by the U.S. 1st Armored Division on 23 May 1944 during the breakout from the Anzio Beachhead.[42]

Mine-Clearing Line Charge. A British-made, rocket-deployed, flexible line charge called the "Conger" was developed to overcome the shortcomings of the Snake. The Conger was the first modern mine-clearing line charge. Consisting of 330 yards of specially woven 2-inch diameter flexible hose, it was launched across a minefield by a 5-inch rocket. After the hose was deployed, it was filled with 2,500 pounds of a nitroglycerine-based liquid explosive known as 822C. Because it was so dangerous, the Conger was used in combat only once by the British 79th Armored Division during the battle for Calais on 25 September 1944.[43] Modern mine-clearing line charges like the U.S. M58 MICLIC and the British Giant Viper evolved from this device.[44]

Mine-Clearing Flail. Lieutenant Colonel Colman, a South African engineer, got the idea for a mine-clearing flail when he saw a tracked vehicle drive by with a length of wire wrapped around its sprockets. The wire hit the ground hard with each revolution of the sprockets. Colman's idea was developed by Field Marshal Montgomery's 8th Army in the general headquarters workshops in August 1942. Twenty-four of these flails, called "Scorpions," were first used in combat during several British breaching efforts in the Second Battle of El Alamein.[45] Eventually, the British consolidated the flail and many other specialized armored vehicles in the famous 79th Armored Division. Commanded by General Hobart, RE, this division—known as Hobart's Funnies—was probably the most advanced combat engineering organization ever developed.[46] Modern descendants of the Scorpion are in service in England and are the forerunner of the jointly developed German and Israeli Keiler system.[47]

Remote-Controlled Breaching Vehicles. The first prototype, remote-controlled breaching vehicles for cutting wire obstacles were developed in Germany and France during World War I.[48] The Germans were the first to produce and deploy remote-controlled minefield breaching vehicles by using both an expendable charge-carrying vehicle (the "Goliath") and a nonexpendable vehicle (the B-IV) that was intended to drop its charge and withdraw before the charge detonated. Although these vehicles were used with some success at Sevastopol in 1942 and Kursk in 1943, they were generally considered failures.[49]

Sea Mines

The Chinese first employed sea mines in the 14th century. The oldest known European design for a sea mine was presented by Ralph Rabbards to Queen Elizabeth I in 1574.[50] In the West, the first known employment of sea mines occurred in 1777 when Captain David Bushnell, an American Continental Army engineer, attacked British ships on the Delaware River with floating mines. He also made the first submarine attack in the history of warfare and commanded the Company of Sappers and Miners that stormed Redoubt 10 at Yorktown.[51] Robert Fulton and Samuel Colt both experimented with sea mines in the early 1800s but lost interest when their efforts were not well received by any government. The term "torpedo" was first applied to Fulton's submarine engine. Floating mines were used by the Russians during the Crimean War in 1855 and at Canton, China, in 1857-58.[52] Their first significant employment, however, occurred during the American Civil War, where they were responsible for most of the Union ships sunk.[53]

Antiaircraft Mines

This type of mine is still emerging from the technological shadows. The first improvised antihelicopter mines appeared during the Vietnam War and were used by the Viet Cong on potential landing zones.[54] During the Cold War, the Russians developed an antiaircraft mine based on their surface-to-air (SA)-7/14 missile for use by their special-purpose forces (SPETZNAZ) against NATO airbases.[55] In the 1990s, Britain and the United States had developmental programs for producing "smart" antihelicopter mines that could be deployed to engage low-flying helicopters, but these have been cancelled.[56] However, a Russian company is looking for partners to help fund the development and fielding of the "Temp 20," an antihelicopter mine with a lethal range of 200 meters.[57] Some of the technologies being developed for the Ballistic Missile Defense Office could even be considered orbiting space mines.

Conclusion

This series of articles has explored the origins of military mines and the ingenuity of the engineers who drove their development. (See *Engineer*, July 1998, for Part I.) The evolution of these necessary but unglamorous weapons will continue. Antiaircraft/antihelicopter mines and possibly antisatellite "mines" will almost certainly appear in the future. So far, history has shown that whenever a new means of movement appears in the attacker's repertoire, the military engineer responds with a defensive countermeasure.

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Endnotes

[1] *A History of Fortification, From 3000 BC to AD 1700*, by Sidney Toy, Heineman, London, 1966, page 31.

[2] Ibid. pages 151-156.

[3] *The Sinking of the USS Cairo*, by John C. Wideman, University Press of Mississippi, 1993, page 51.

[4] *Reminiscences of General Herman Haupt*, by Herman Haupt, Arno Press, 1981 edition, page 49.

[5] *The Fighting Tanks Since 1916*, by Ralph Jones, George Rarey, and Robert Icks, The National Publishing Company, Washington, D.C., 1933, page 262. See also FM 20-32 (1976), page 133.

[6] "Destruction of Enemy Traps and Mines," by J. Frank Barber. *Military Engineer*, September-October, 1924, pages 374-377.

[7] Ibid. pages 47, & 106-114, also see *Treat 'em Rough! The Birth of American Armor,1917-20*, by Dale E. Wilson, Presidio, 1989, pages 117, 170, 182, 196, and 204.

[8] *Mine/Countermine Operations at the Company Level*, FM 20-32, Department of Doctrine and Training Development, US Army Engineer School, Fort Belvoir, Virginia, 30 September 1976, page 133.

[9] *German Mine Warfare Equipment*, TM 5-223C, March 1952, pages 118-122. See also pages 89-94.

[10] *Deutsche Landminen, 1935-1945*, by Wolfgang Fleischer, Waffen-Arsenal, Band 164, Podzun-Pallas-Verlag,1997, pages 12 and 43.

[11] *Soviet Mine Warfare Equipment*, TM 5-223A, Department of the Army, August 1951, pages 45-52 and 83-89.

[12] Ibid. pages 113-116.

[13] *North Korean People's Army Handbook*, FC 100-2-99, Battle Command Training Program, April 1992, page 10-36.

[14] *Soviet Mine Warfare Equipment*, TM 5-223A, Department of the Army, Washington, D.C., August 1951, pages 62-63.

[15] *Jane's Military Vehicles and Logistics, 1991-1992*, edited by Christopher Foss and Terry Gander, Jane's Defence Data, Great Britain, 1991, pages 199-200 and "Smart Mines Join the Fray," Armed Forces Journal, August 1992, page 14.

[16] *North Africa, 1940-1943, Landmine and Countermine Warfare*, Engineer Agency for Resources Inventories, Washington, D.C., June 1972, pages 15, 20, 30, 50, and 51.

[17] *Italian and French Explosive Ordnance*, TM 9-1985-6, Departments of the Army and the Air Force, March 1953, pages 3, 25, 59-60. And *German Explosive Ordnance (Bombs, Fuzes, Rockets, Land Mines, Grenades, and Igniters)*, TM 9-1985-2, Departments of the Army and the Air Force, Washington, D.C., March 1953, page 34.

[18] OP CIT, *North Africa, 1940-1943, Landmine and Countermine Warfare*, page 15. *Luftwaffe Handbook, 1939-1945*, by Alfred Price, Charles Scribner's Sons, New York, New York, 1997, page 42. *Unexploded Bomb, A History of Bomb Disposal*, by Arthur Hartley, W. W. Norton & Company, New York, 1958, pages 132-134, 159-165, and 213.

[19] *German Air Force Operations in Support of the Army*, by General der Flieger and. D. Paul Deichmann, USAF Historical Studies: No. 163, USAF Historical Division Research Studies Institute Air University, Arno Press, New York, June 1972, pages 43-44.

[20] *The 1st Cavalry Division and Their 8th Engineers in Korea*, edited by Frank Armstrong, Bull Run of Vermont, South Burlington, Vermont, 1993, page 180.

[21] *Viet Cong Boobytraps, Mines, and Mine Warfare Techniques*, TC 5-31, Headquarters, Department of the Army, December 1969, page 2-11.

[22] *German Mine Warfare Equipment*, TM 5-223C, Department of the Army, Washington, D.C., March 1952, page 10. The device proved "impractical." See also a video titled "Great Fighting Machines of WWII." The first fielded mechanical mine planter was probably Russian.

[23] OP CIT, *Jane's Military Vehicles and Logistics, 1991-1992*, pages 217-218.

[24] *Medieval Warfare*, by Terrence Wise, Hastings House Publishers, New York, 1976, pages 168-169.

[25] OP CIT, *A History of Fortification*, page 23.

[26] Ibid. pages 99-100.

[27] *War Underground, The Tunnellers of the Great War*, by Alexander Barrie, Tom Donovan, London, England, pages 196-206.

[28] *European Weapons and Warfare, 1618-1648*, by Eduard Wagner,Octopus Publishing, page 222.

[29] *Infernal Machines, The Story of Confederate Submarine and Mine Warfare*, by Milton F. Perry, Louisiana State University Press, 1965, pages 58-60.

[30] *Encyclopedia of Tanks*, by Duncan Crow and Robert Icks, Chartwell Books, page 135 and 164.

[31] *The Story of the 79th Armoured Division*, privately published, June 1945, page 45.

[32] "Mine and Countermine in Recent History, 1914-1970," by Russel Stolfi, BRL Report 1582, Ballistic Research Laboratories, Aberdeen Proving Grounds, Maryland, April 1972, page 21.

[33] OP CIT, *Encyclopedia of Tanks*, page 31.

[34] *Royal Engineers*, by Derek Boyd, Leo Cooper Ltd., London, 1975, page 72.

[35] *Western Europe, World War II, Landmine and Countermine Warfare*, Engineer Agency for Resources Inventories, Washington, D.C., July 1973, page 205.

[36] OP CIT, *Jane's Military Vehicles and Logistics, 1991-1992*, pages 235 and 249.

[37] OP CIT, *Royal Engineers*, pages 75-76.

[38] *The Winter War, The Russo-Finnish Conflict, 1939-40*, by Eloise Engle and Lauri Paananen, Charles Scribner's Sons, New York, page 77.

[39] *Soviet Tanks and Combat Vehicles of World War Two*, by Steven Zaloga and James Grandsen, Arms and Armour Press,

London, pages 62, 81, 84, 85, 190, & 191. See also, *Bagration 1944, The Destruction of Army Group Centre,* by Steven Zaloga, pages 33, 34, and 49.

[40] OP CIT, *Jane's Military Vehicles and Logistics, 1991-1992,* pages 234, 235, 238, and 240.

[41] *History of the Corps of Royal Canadian Engineers, Volume II, 1936-1946,* by A. J. Kerry and W. A. McDill, The Military Engineers Association of Canada, Ottawa, 1966, page 99. However, it is possible that the Germans were first, see *German Mine Warfare Equipment,* pages 215-216.

[42] *Cassino to the Alps, The Mediterranean Theater of Operations,* by Ernest Fisher, Center of Military History, US Army, Washington, D.C., 1977, 120-128.

[43] OP CIT, *The Story of the 79th Armored Division,* page 136.

[44] OP CIT, *Jane's Military Vehicles and Logistics, 1991-1992,* pages 238, 242, 247, & 248.

[45] *Taming the Landmine,* by Peter Stiff, Galago Publishing, Alberton, South Africa, 1986, pages 23-28. Alternatively, the Russians may have been first, see *Soviet Tanks and Combat Vehicles of World War Two,* page 62.

[46] *Vanguard of Victory, The 79th Armored Division,* by David Fletcher, Her Majesty's Stationery Office, London, 1984.

[47] OP CIT, *Jane's Military Vehicles and Logistics, 1991-1992,* page 232.

[48] OP CIT, *Encyclopedia of Tanks,* pages 133 and 143.

[49] *German Remote-Control Tank Units 1940-1943,* by Markus Jaugitz, Schiffer Military, Atglen, Pennsylvania. These devices are arguably related to the much older concept of a "fire ship" from naval warfare.

[50] *The Genius of China,* by Robert Temple, Simon and Schuster, New York, 1986, page 237.

[51] *Engineers of Independence, A Documentary History of the Army Engineers in the American Revolution, 1775-1783,* by Paul K. Walker, Historical Division, Office of the Chief of Engineers, Washington, D.C., page 185.

[52] *Torpedoes: Their Invention and Use, From the First Application to the Art of War to the Present Time,* by W. R. King, Washington, 1866, page 34-86.

[53] OP CIT, *Infernal Machines, The Story of Confederate Submarine and Mine Warfare,* page 4.

[54] OP CIT, TC 5-31, pages 4-14 and 4-15.

[55] *On Air Defense,* by James D. Crabtree, Praeger, Westport, Connecticut, 1994, pages 183-184.

[56] OP CIT, *Jane's Military Vehicles and Logistics, 1991-1992,* page 198 and "Anti-Helicopter Mine" Brochure, Ferranti International, undated.

[57] "Russia Unveils Anti-Helicopter Mine Project," Jane's International Defense Review, 1/1998, page 16.

(Continued from page 43)

Sell the Idea

No matter how great his ideas, an engineer is worthless to those he supports if he cannot sell himself and those ideas. Unfortunately for engineers, infantry and armor officers make the final call on the brigade SOP. New ideas are a hard sell, especially to those comfortable with the "old ways." Engineers in the 3BCT developed a PowerPoint slide presentation that shows the Class IV/Class V supply flow on the battlefield. This presentation points out to the task force S4s that the supply point is their responsibility and demonstrates with the "WELCOMES" card how easy their job can be. After the 3BCT commander blessed the concept, it was included in the brigade's noncommissioned officer and officer development plans. Then, with a measurable amount of insistence on the part of the engineers, the Class IV/Class V supply flow was exercised during the home station train-up for the National Training Center. After receiving guidance, the task force S4s took ownership of their supply points and ran them quite well. This achieved the brigade commander's intent to free up the engineers and use the brigade's limited assets to push enough material to keep those engineers gainfully employed on the ground.

Maximize Assets

FM 20-32, *Mine/Countermine Operations*, states that "Mine warfare logistics at the task force level can be complex. It requires prudent use of scarce haul and materiel handling equipment and demands positive command and control." With dwindling resources in personnel and equipment across the Engineer Corps, it is paramount to use all the brigade's assets for Class IV/Class V supply point operations. Training maneuver elements in the brigade before they deployed to the National Training Center paid high dividends for the 3BCT—and it would be time well spent during any brigade's train-up. Key tasks for engineers are to simplify doctrine, assign responsibilities, sell the idea, and train maneuver elements to take ownership of the supply point. When a unit can free engineers from processing mines and mass their efforts on mine emplacement, they have cracked the code on Class IV/Class V supply point operations.

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Through the Breach: A Tanker's Perspective

By Captain Jeffrey Erdley

> *"Operation Desert Storm showed that our World War II vintage minefield breaching and clearing capability, coupled with he lack of demolition expertise, resulted in an inability to technically or tactically breach the modern minefield that we faced."*
>
> *Operations Desert Shield/Desert Storm Engineer Observations*

Quotes such as this may stir emotions of disbelief in U.S. forces, because all of the breaches during Desert Storm were successful. It is important to note, however, that the majority of our forces (except the Marine divisions and a 2d Armored Division brigade) maneuvered far to the west of the main defenses. In every case, the Iraqi resistance was vastly weaker than predicted—a fact that thankfully negated the 80 percent casualty predictions for U.S. breaching forces.

I served as an acting engineer platoon leader with B/23rd Engineers (1st Armored Division) for a Combat Maneuver Training Center, Hohenfels, rotation and conducted well over 100 breaches as a tank platoon leader, executive officer, and acting commander of armor-heavy teams. I have held both tanker and engineer viewpoints through field training in local training areas and combat training centers and formal schooling at Fort Knox and Fort Leonard Wood. Through my experience, one fact has proven itself over and over: the maneuver arms and engineers lack a common understanding of breaching and only work together when forced to conduct a breach.

Breaching Issues

FM 90-13-1, *Combined Arms Breaching Operations*, lays the framework for a common vision, but the principles of this manual are not always followed or understood by units in the field.

FM 71-2, *The Tank and Mechanized Infantry Battalion Task Force*, states, "Combat engineers are located with the breaching force of the battalion to perform hasty breaches. However, time and distance factors may require a hasty breach by maneuver units without direct engineer participation." Likewise, engineers are often thrust forward of both light and mechanized units and are told to reduce obstacles with little more than direct-fire support. The disjointed guidance may be corrected in future versions of FM 71-2, because engineers don't use the term "hasty," and the new FM 90-13-1 will eliminate each distinct operation (deliberate, in-stride, etc.) and designate them all simply as a "breach."

In my experience, engineer and maneuver soldiers when faced with a breach often view each other as adversaries who get in the way of the mission. An important point is that creating a lane through an obstacle is not conducting a breach; it is one small part of the operation. A breach is a combined arms operation involving not just engineers and tankers but every battlefield operating system (BOS) element. Somewhere in the middle of the engineer and armor "high grounds" is an effective way for these branches to work together to breach an obstacle and continue with an attack. This is where task force and brigade combat team rehearsals and training become essential—before units deploy to the field. It is imperative for the unit to develop a cohesive plan for a breaching operation as early as possible and to bring all participating elements together to orchestrate the complex operation. Through refinement, the breaching plan is developed and captured in the unit's standing operating procedure (SOP) as an effective reference for both maneuver and support units.

Current doctrine does not provide insight concerning an effective middle ground for breaching operations. Most armor manuals reserve a few pages to roller and plow operations and simply state that armor units will get support from the engineers for large obstacles. Engineer manuals are also lacking. For example, the obstacle-reduction capability of tanks is viewed as an afterthought, mainly for proofing. Even FM 90-13-1, the doctrinal bible on breaching operations, barely mentions tank obstacle reduction. It states that plows and rollers are mechanical reduction assets but does not explain how to employ them. FM 20-32, *Mine/Countermine Operations*, devotes one page each to the plow and roller. (Lest we forget how important tanks are, it was the introduction of British tanks that opened the wire and trenches in France to help end the stalemate of World War I.) Since there is no effective manual on the tactical employment of either the plow or the roller, tankers must discover the tactics, techniques, and procedures (TTPs) for unit SOPs and operations on their own. To spur ideas and raise awareness, I offer some personal observations on identifying obstacles, ways to maneuver to them, notes on equipment, and breaching techniques that have proved successful in the field.

Obstacle Intelligence

As with any successful combat operation, a successful breach begins with accurate reconnaissance. Through trial and error, 3-67 Armor learned that the most effective method of locating obstacles, bypasses, and potential reduction sites was to put an engineer in a scout vehicle that overwatched named areas of interest and have him gather obstacle intelligence. Armor battalion scouts know the task force or brigade combat team commander's intent and have the "maneuver view" of how to conduct the operation. But no one has more knowledge of obstacle composition, dimensions, and purpose than engineers. When they are in the same vehicle, armor and engineer soldiers form an efficient team to locate obstacles and locate and mark potential bypasses or create lanes not covered by fire. Other reconnaissance assets, such as the brigade reconnaissance troop, unmanned aerial vehicles, scout helicopters, and combat observation lazing teams, may be available depending on the priority of the mission in the overall scheme of operations.

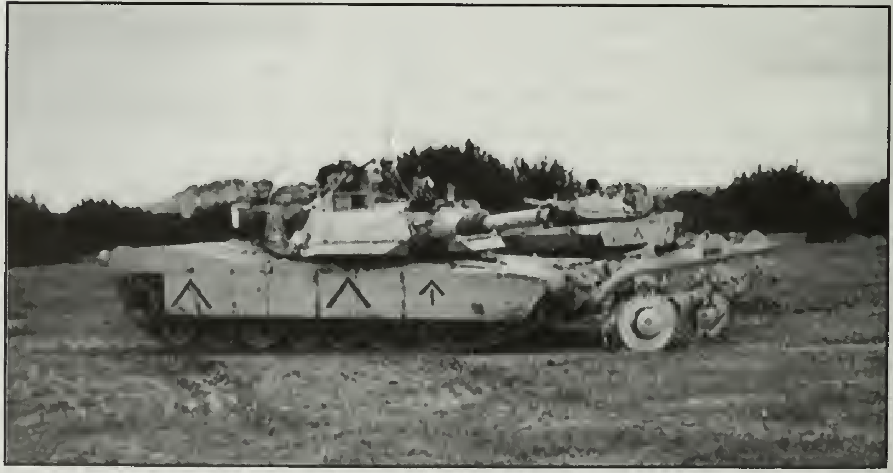
Breach Operation Planning

Even as reconnaissance personnel are being deployed, the commander and staff must start planning for a breach in every offensive course of action. It is safe to assume that our forces will be under both direct and indirect fire, because the enemy uses obstacles to channel and separate forces just as we do. With the speed of breaching operations in mind, the task force or brigade combat team breach force must maneuver toward the front of the formation. If a breach is imminent, their best location is second in the order of march.

Both FM 17-15, *Tank Platoon*, and FM 71-2 state that the roller tank should lead in a breach, because it is designed to detect minefields. This technique may be effective if units cannot visually identify mines or locate them with the tank's thermal sites. The roller tank may also find enemy scatterable mines. With the density of conventional and scatterable mines, however, the roller tank may be well past the leading edge of the minefield before the roller hits a mine and thus determines the minefield's location.

I have not observed this order of march to be effective, because the roller tank is a massive, lumbering beast that is ill-suited to lead a combat formation. Lead tanks should not have mounted equipment, because they must be killers on point that clear the immediate area for the formation and fix enemy vehicles with direct fire. Tanks with plows and rollers should then move behind terrain or at a safe distance to the rear of the lead tanks.

Within a tank company, the modified table of organization and equipment distributes one plow to each



An A/3-67 Armor M1A1 moving to a company assembly area. Note the deliberate orientation of the gun tube away from the roller assembly.

platoon and a roller on another tank in the company. Since tank platoons rarely maneuver on their own and never maneuver alone in a breach, this division of resources is a serious violation of unity of command that is usually corrected through task organization in the field. The most effective breach forces I have seen have had *all* of the reduction assets massed in one platoon. In a few missions, we attempted to attach this platoon under an engineer company commander. However, these attempts had disastrous results because the units did not use guns in the battle. Tanks were treated as engineer vehicles, and the company's killing capability was reduced by one-third.

To be successful, both maneuver and engineer chains of command must remain intact. Although the maneuver commander commands the breach force, the engineer commander may control the reduction element within that force. This organization allows the maneuver commander to concentrate on the security element and the critical task of controlling direct fire at the reduction site.

Mobility Assets

The equipment available for a breach is not limited to tank and engineer armored vehicle-launched bridges (AVLBs), mine-clearing line charges (MICLICs), armored vehicle-launched MICLICs (AVLMs), bangalore torpedoes, and grappling hooks. A successful breach is a combined effort involving engineers; indirect, counterbattery, and smoke missions of field artillery; mortars; aviation fires; infantry support; and sometimes chemical corps smoke. All these systems are excellent in their own way, but this article concentrates on integrating the M1 tank with mine-clearing plows and rollers with engineers.

Armor Equipment

Armor manuals are fairly weak on describing breaching missions. Three breaching methods are discussed in FM 71-2: employing an M1 tank with a plow/roller combination, using an M88 recovery vehicle with its blade down, and simply driving through. FM 17-15 describes the disastrous method of staggering plow tanks to create wider lanes. This method often leads to a live mine in the spoil that explodes on the second tank. FM 17-15 also instructs tank platoon leaders to use the cleared-lanes marking system (CLAMS). I believe that most of these systems were turned in after they proved to be ineffective.

In my opinion, the most effective method of tank obstacle reduction is with the plow tank. It digs below mines and then uses spoil to push them to the sides. Any vehicle that stays within the track of the tank is safe from mines.

Contrary to the belief of some soldiers, a plow does not necessarily slow a tank during movement. The main planning consideration for plow tanks is to keep them away from wadis, streambeds, bridges without the appropriate military load classification, and other restricted terrain that would impede movement. A tank is much longer with a plow attached and cannot drive through steep dips. If a plow digs in, crews must scrape the mud and dirt off immediately. If they don't, the added weight may cause seals to burst on the suspension in the front of the tank.

Roller tanks have some uses but generally are considered to be more trouble than they are worth in the armor community. Several tank manuals suggest leading an attack with a roller tank to find the leading edge of the minefield. However, anyone who has maneuvered with them understands that an attack with a roller point man would have all the momentum of a lethargic snail. Rollers were designed to be carried to the battlefield on a lowboy trailer, and the receiving tank would already have a mounting kit secured to the front slope. The crew only installs rollers on a tank in the attack position before crossing the line of departure, then it maneuvers through the breach as the proof tank and drops the rollers on the far side to be retrieved later. In this mission, and this mission only, a roller is effective. Prolonged use of a roller is suicide to a tank. During one field exercise, a wingman left the roller on a tank for an entire month because the unit lacked support to transport it. It took about nine months to replace or repair all the shocks and seals of the tank's suspension that were destroyed by the extra weight.

There is a major Class IX supply problem with both the plow and the roller. These systems are not reportable and can lose deadline visibility. Neither system is reportable, so we could order all the parts 02 priority, nondeadline. Even with this priority, the average shipping time for plow parts is about nine months and about a year for roller parts. Crews that cannot repair deadlined systems do not train on them. After a short time, no one in the unit is familiar with the equipment and it is ignored. Even item managers could not help us get parts faster because of the lack of emphasis on this vital equipment.

Engineer Equipment

During most of the heavy task force operations I have been involved with, engineers believed that the best breaching equipment was the MICLIC and the AVLM. The prevailing belief among armor personnel when they saw the MICLIC or AVLM being prepared for the point of breach was: "Get the plows ready, the MICLIC won't work." Engineer after-action reports from Desert Storm contain the following conclusions:

"Units placed an overreliance on the MICLIC as the answer to all their breaching problems. This was due to the ignorance of threat mine capabilities, poor MICLIC training at home station, and the general lack of an effective training device or training strategy."

"The MICLIC system suffered from several serious shortcomings. During test firings the system suffered a 50-percent failure rate."

Even when the MICLIC fires successfully, it can only clear a 100-meter-long path in an obstacle. This is excellent for small obstacles, but not for the deep obstacles found in many breaching operations. FM 90-13-1 acknowledges that the MICLIC has a "skip zone," where mines are left untouched. Also, deeply buried mines, nonpressure-fuse mines, and overpressure-resistant mines are very resilient against the MICLIC. A major advantage of tank-mounted systems is that they can keep going through an obstacle without a lengthy firing process. Since engineers cannot accomplish a breach alone, it is essential that they work closely with tankers to perform the operation.

Reduction Techniques

The possible combinations of breaching assets and methods to use them are almost unlimited. The methods I have used most are the MICLIC/plow tank combination and the plow tank/roller combination. But regardless of the method, all breaches must be the task force's or combat team's main effort. Because an attack hinges on the breach mission, every asset—including most of the ammunition, close air support, fire priority, firefinder radar, and smoke platoons—must be concentrated at this decisive point. Using these assets, the commander must build the breach fundamentals of suppress, obscure, secure, and reduce. To accomplish this, he organizes the breaching unit into support, breach, and assault forces. When forming these forces, he must retain unit integrity and the existing chain of command.

Success hinges on keeping those platoons or companies intact under the maneuver commander, with the engineer commander as a right-hand man. When teams are in place and firing on the enemy, the support force commander calls for indirect fires and smoke missions. His mission dictates a good view of the battlefield, which gives him the best overall view to control these fires. Artillery and armor battalion mortars must be used to the fullest for fires and smoke missions. If they fail, tanks can fire volleys of high-explosive antitank rounds in front of enemy positions to create obscuration from soil. When the effects of all these systems peak, then and only then has the force set the conditions for commitment of the breach force. Regardless of the breaching method used, the end state must be the same: The maneuver force must get through a breach quickly to continue the assault and kill the enemy.

MICLIC/Plow Tank Method

After setting the conditions for commitment of the breach force, most engineers I've observed have moved the plow tank in position in front of the obstacle with the MICLIC directly behind it. In this technique, the MICLIC is the reduction asset and the plow is the proofing system. This technique provides some cover for the MICLIC crew while they are exposed to the enemy for the minutes it takes to raise, lock, fire, and detonate a charge. A well-trained tank crew also may help set up the engineers for success on the MICLIC launch by halting at the correct stand-off distance for launching and then positioning the tank perpendicular to the obstacle. After the explosion, the tank is in position to plow through the obstacle while the enemy is still disorganized from the detonation. While the MICLIC crew is getting ready to fire, the tank crew can drop the plow and verify that it is locked down. Once the rocket is fired, the obstacle is quickly reduced.

From a tanker's perspective this technique works, but it includes actions that could lead to failure for the breach force. It is critical that the attacker place a large volume of fire on the defender during the entire mission. However, with the plow tank directly in front of the breach, where our obscuration smoke and burning enemy vehicles may obscure the enemy's view, his main gun is effectively taken out of the fight. When the enemy sees the tank and MICLIC at the point of breach, he has a large target (two vehicles end to end) to aim at for several minutes. This is when everyone learns if the suppressive fire was effective or not. During this time, enemy forces can destroy the attacker's best tools for getting through the breach and deny the commander the best place to enter the lane. Even if the plow tank crew survives the enemy fire, a 25-year-old friendly vehicle with a misfire rate of about 50 percent is about to fire almost a ton of high explosives over their heads.

Immediately after the MICLIC fires, the plow tank begins to move through what is left of the wire and mines. The tank must go on a straight path, because it cannot turn without risking damage to the plow tines. The turret should be traversed to the left, so that any mine blast to the front does not damage the gun tube. If the turret is traversed to the right, the tank commander is farther back and has problems seeing the front to determine the far edge of the obstacle. Some crews install a makeshift wire-cutting device in the center of the blades. This allows them to cut and push away the wire, so it won't be dragged along. The wire won't stop the tank, but it could damage the plow by cutting the nylon lifting straps or getting caught in the track.

Armor and engineer doctrine on plow tank employment present the extremes of plow performance, while the best answer lies somewhere in between. Many armor and joint doctrinal publications state that the crew can drop the plow blade as little as 10 meters in front of the obstacle and then plow up to 10 miles per hour (see FM 71-2). (The M1's speedometer is in kilometers per hour.) The tank platoon Army Training and Evaluation Program lists no standards. Engineer manuals bring the blade drop point back to 100 meters with a speed below 10 kilometers per hour (see FM 20-32). Both specifications are partly right and partly wrong.

The only way to be sure the depth setting and plow speed are effective is to conduct a rehearsal. By plowing two or three practice lanes in the area of operations with conditions similar to hose at the obstacle, the commander can determine the best depth and speed o dig out mines and produce sufficient spoil to push them to the sides. The blade drop point and speed also can be efined during a rehearsal. It is best to drop the blade before beginning to move to avoid possible damage to the plow tines. After the plow creates a ane, the roller follows the same path hrough the obstacle to detonate any remaining mines. The roller should ravel at the same speed as the plow, with the gun tube to the left, and then exit the lane to the right in a hasty defensive position. In theory, each roller can withstand two mine hits and continue to effectively proof the lane. Regardless of the method used, several systems must work together to breach, proof, and mark lanes.

A plow can dig down to 8, 10, or 12 inches. The depth must be set before the mission begins and is based on ground conditions (the softer the soil, the deeper the setting). The depth is critical, as is installation of the plow's moldboards, which force spoil farther to the sides of the tank and create a wider lane while preventing mines from falling back into the lane. After the tank commander is sure that the plows have plowed beyond the far edge of the obstacle, the tank must briefly stop, back up, and raise the plow. This only takes a few seconds. Then the plow tank should move to the left of the breach lane and remain in a suppressive fire position. Because the plow control cables run through the driver's right vision block, he should drive to the left so he can see where he is going. Meanwhile, the gunner traverses and looks for targets.

Although the lane is now well established, it is not complete until it is marked. The MICLIC and the path dug by the plow are very distinctive, so the immediate concern is to mark the exact entrance and exit. VS-17 panels are excellent markers at each end. We used the red side on the right and orange on the left. The exit point is the most critical under fire, because many combat vehicles turn off too early in training and run into the minefield. At night, plastic water bottles filled with chemical light fluid enhance the VS-17s. We used markers called "tippy toms" to mark the left handrail of the lane because engineers can throw them out as they move through, but they usually are not very useful after the path is dug. Any initial method that clearly marks the entrance, exit, and path of the lane is satisfactory but should be continually improved for follow-on units (see FM 90-13-1, Appendix E).

Plow/Roller Tank Method

When tank units train to reduce obstacles without a MICLIC or AVLM, they use only a plow and roller. They follow the basic tenants of breaching as with the MICLIC/plow combination, but this method uses the plow to reduce and the roller to proof. Without a roller, tank units are forced to drive a "Hollywood" tank through the obstacle first to proof the lane. It is a grim job, but if the tank doesn't hit a mine, then the lane is proofed. Regardless of which reduction/proofing combination the commander uses, the plowing portion is almost identical to the process described for the MICLIC/plow combination. The only difference is in how the plow tank begins its mission. When terrain allows, a plow tank is most effective if it remains behind an intervisibility line while conditions are set for the breach. The commander can talk directly to the tank commander and position him directly in front of the desired breach point, so that when he orders the plow forward it quickly drives straight to it. This is another instance where doctrine falls apart. Determining the blade drop point and tank speed may seem simple, but they drastically affect the quality of the lane.

Synopsis

In heavy-force breaching operations, the maneuver commander must synchronize every available BOS to set the conditions for a successful breach and continued attack. No one system or branch can accomplish this mission without direct involvement and assistance from others. A major problem facing the combined arms team today is a lack of understanding of the common doctrine in FM 90-13-1 on how to execute this mission. The primary soldiers in a breach are tankers and engineers, but our schools teach different execution methods. Then, when we come together in the field to plan and execute a mission, the officers disagree on exactly what to do.

To eliminate this confusion, we must develop more effective combined arms doctrine and TTPs for obstacle reduction. If we begin by locking a group of tanker sergeants and captains in a room with their sapper counterparts, they may be able to find some common ground before the next balloon goes up. Common techniques will allow tankers and engineers to complement each other in a combined arms breach and be reinforced by every available BOS. Through combined TTP development, refinement, implementation, and training, we can set the conditions for a successful combined effort of all BOS elements on the battlefield. As individuals, or individual units, we can do many great things. Acting together as a cohesive team with common doctrine, we can accomplish anything—even an operation as demanding as a breach.

Captain Erdley is working on a master's degree in engineering management at the University of Missouri-Rolla. He has served as a tank platoon leader, executive officer, battalion maintenance officer, and S1 for 3-67 Armor in 2d Armored Division and 4th Infantry Division (Mechanized). He is a graduate of the Airborne, Air Assault, Armor Officers Basic, and Engineer Officers Advanced Courses. CPT Erdley is a 1994 Distinguished Military Graduate of Lehigh University, Bethlehem, Pennsylvania.

Past in Review

Fighting Kuwait's Oil Fires

By Janet A. McDonnell

During the Gulf War, the U.S. Army supported what was by all accounts the largest oil-fire-fighting campaign in history. Overall responsibility for fire-fighting operations rested with the Kuwaiti government and its Ministry of Oil. Kuwaiti leaders decided early on that the Kuwait Oil Company would manage and direct all fire-fighting operations.

Before the Iraqi invasion (in August 1990), Kuwait had roughly 1,300 producing wells in its primary oil fields. Approximately 75 of them were high-pressure wells in the important Burgan field that produced from 20,000 to 50,000 barrels of oil a day. Kuwait had a production quota of 1.5 million barrels per day, set by the Organization of Petroleum Exporting Countries (OPEC), though it could produce much more.

As Iraqi soldiers withdrew from Kuwait, they blew up more than 600 oil wells, resulting in the loss of an estimated 5 to 6 million barrels per day. Roughly 520 of the wells, or 85 percent, burned at temperatures as high as 2,000 degrees Fahrenheit. The rest gushed thousands of barrels of crude oil into large, dark, lifeless "lakes" that were up to six feet deep. Onlookers hundreds of feet away could feel the intense heat and hear the roar of the burning wells, similar to the sound of a jet engine. Thick smoke shrouded the fields. To further complicate matters, unexploded ordnance and Iraqi land mines littered the oil fields. The country's three refineries—Shuaiba, Mina Abdulla, and Mina al Ahmadi—were also damaged.

The Kuwait Oil Company directed the early planning for the fire fighting in Washington. The Kuwaitis requested U.S. Army civil affairs support in the planning effort. Members of the Kuwait Task Force (a small group of reserve officers from the 352nd Civil Affairs Command) helped the Kuwaitis gather information about the well fires, plan logistics support, and develop an emergency plan of action. The Kuwait Oil

Company hired O'Brien, Goins and Simpson as the executive agent to coordinate fire-fighting activities. It signed contracts with Red Adair Company, Boots and Coots, and Wild Well Control, Inc., all skilled Texas-based, world-renowned firms; and with Safety Boss of Calgary, a well-qualified Canadian firm. The Kuwait Oil Company eventually hired Bechtel to reconstruct the oil infrastructure and to provide food, housing, and other support to the firefighters, but Bechtel had no direct role in putting out the fires.

It took the Kuwaitis four months to award the first fire-fighting contract, and they hired firefighters before hiring a contractor to support them. A severe shortage of heavy equipment, such as bulldozers, backhoes, and trucks, hampered the fire-fighting effort. Because of theft and Iraqi destruction, virtually everything needed to support the operation had to be imported. The challenges of feeding, housing, and equipping a workforce that eventually grew into the thousands were staggering.

Firefighters arrived to survey the damage, assess their personnel requirements, and determine where they could stage their equipment. The first experts from Red Adair, Boots and Coots, and other companies arrived in Kuwait City on 4 March and toured the burning oil fields by helicopter. They estimated that extinguishing the fires and repairing the wells could take two years.

Initially, the contractors could not bring in workers because they had no way to feed or house them. The companies also had trouble getting the necessary equipment. The Kuwaitis initially were reluctant to invest the tens of millions of dollars needed for equipment, even though the fires consumed roughly $100 million worth of oil each day.

Members of the Kuwait Task Force provided immediate logistics and communications support to the fire-fighting teams. They also provided ground and air transportation to assess damage in the burning fields. Civil affairs troops coordinated the use of C-5A aircraft to bring in heavy fire-fighting equipment from Texas and to provide firefighters with food, water, lodging, and helicopter and truck transportation. This gave the Kuwaiti government enough time to bring Bechtel personnel on-site to take over the support operations. The Kuwait Task Force also provided explosive ordnance disposal support and training and coordinated engineer support until Kuwaiti equipment arrived. Army explosive ordnance disposal specialists steered the firefighters safely through unexploded ordnance to the wellheads and checked the wellheads for explosives.

Kuwait Task Force members, Major Tom Wilson, a procurement specialist with Hunt Oil Company in civilian life, and Lieutenant Colonel Phil Huber, focused on fire issues. Task force members coordinated between the firefighters and Ambassador Edward Gnehm. They also coordinated between contractors looking for work and Bechtel or the Kuwait Oil Company.

An estimated 5 to 6 million barrels of oil a day were lost.

Because of the shortage of equipment and firefighters, the work got off to a painfully slow start. The Kuwait Oil Company initially used nine teams that represented the four fire-fighting companies. Fire-fighting equipment began arriving in Kuwait on military aircraft throughout March, and on 7 April a Boots and Coots team used liquid nitrogen and water to extinguish the first oil-well fire. Fighting the wellhead infernos was dangerous and difficult. The firefighters worked in intense heat, amid blowing sand and smoke, and their brightly colored jumpsuits quickly became coated with an oily mist.

In April, Kuwait's oil minister, Dr. Rashid Al-Amiri, announced that the national oil company would bring in fire-fighting teams from several different companies, breaking up the American and Canadian monopoly. With only 25 well fires extinguished, he wanted to

Firefighters cap an oil well in Kuwait in August 1991.

quicken the pace. The Kuwaiti government later brought in teams from three additional U.S. companies as well as British, German, French, Russian, Chinese, and Iranian firms. Ultimately, however, teams from the original American and Canadian firms put out most of the fires. Meanwhile, firms and individuals from around the world continued to inundate U.S. and Kuwaiti officials with proposals for extinguishing the fires.

The slow pace of the fire fighting worried U.S. officials. In April, the Office of the Principal Deputy Undersecretary of Defense for Strategy and Plans hosted a meeting for representatives of the Army, Navy, Air Force, and Department of Energy to address this issue. The Deputy Assistant Secretary of Energy for Export Assistance, George Helland, warned that the Bush administration would come under attack if it did not act quickly to put out the oil fires. The participants decided to forward all proposals for extinguishing the fires to the Undersecretary of Energy. He would screen the proposals before forwarding them to David Tarbell, the Director of International Economic and Energy Affairs, in the Office of the Principal Deputy Undersecretary of Defense for Strategy and Plans. The participants, however, made no attempt to define the problem. They failed to develop any specific format or guidance for drafting proposals and failed to develop any initiatives to get support from high levels in the Pentagon or the Bush administration. These were important oversights.

After Task Force Freedom ceased operations, the Army continued to support the fire-fighting effort through the Defense Reconstruction Assistance Office. Neither the Kuwaiti government nor any of the commercial firms could quickly bring in needed supplies and heavy equipment. As a result, with little legal or funding authority, the Military Airlift Command found itself flying the cargo on U.S. Air Force C-5A transports. The Defense Reconstruction Assistance Office later helped broker more than $13 million in transportation expenses between the Military Airlift Command and the Kuwaiti government. Other Defense Department agencies provided support through satellite imagery photographs, airfield repair, and environmental surveys.

Major General Patrick Kelly, Commander of the Defense Reconstruction Assistance Office in Kuwait, and his staff monitored the work, gathered information, and kept the U.S. Ambassador to Kuwait, Edward W. Gnehm, informed. Gnehm had no environmental specialists on his staff, so he relied on Kelly's environmental officer, Lieutenant Colonel Christopher Werle, to advise him and coordinate environmental issues. Where appropriate, Kelly's staff helped coordinate the delivery of heavy equipment on C-5A transports, the tracking of oil fires and spillage with Landsat imagery, and the stabilization of work sites with airfield matting. Werle, who performed much of the day-to-day coordination with the fire-fighting organizations, developed a particularly good rapport with the firefighters and their support crews. Kelly and his staff considered all activities related to the environment and the oil-well fires to be "embassy business" and took no action without the ambassador's approval.

The Army also provided combat engineer vehicles (CEVs). These vehicles are tanks with turret-mounted demolition guns and hydraulically operated debris blades. They give engineers in forward combat areas a versatile means of clearing rubble and filling tank ditches. More than 80 Kuwaiti oil fires were encircled by huge, hardened mounds of coke (solids produced when unburned oil mixed with sand), which had to be removed before the firefighters could work. Firefighters used dynamite and backhoes to remove the searing mounds, but the process was hazardous and slow. Werle developed a plan to use existing CEVs to fire rounds of high explosive plastic at mounds to break them up so the firefighters could remove the debris. This plan, he argued, would speed the capping effort and save the Kuwaiti government $300,000 per well. Moreover, it would provide unique training for the CEV crews and positive Army public relations. The Kuwait Oil Company covered the costs of using the CEV crews and equipment.

On 31 July, the Kuwaiti government and Bechtel conducted a very successful experiment: firing the large-caliber gun on a CEV to remove coke mounds from wellheads. Rounds from the vehicle shattered four out of five of the coke-mound targets. Soldiers cleared two wells using this method. Soon after the initial experiment, however, the focus of the fire-fighting effort shifted to Burgan, Kuwait's densest oil field. Officials concluded that using the CEVs there would be too dangerous because the wells were so close together.

As the oil fires continued to burn, the U.S. Army and other agencies became increasingly concerned about the short- and long-term health risks of the smoke and other emissions. In March 1991, an interagency team headed by the Environmental Protection Agency collected samples at several sites in Kuwait, Saudi Arabia, and elsewhere in the Middle East. They attempted to ascertain the presence of potentially harmful air pollutants, specifically carbon monoxide, sulfur dioxide, and hydrogen sulfide gases and particulates—tiny particles that lodge in the lungs. The team found each of these gases but not in concentrations that exceeded current standards. The Environmental Protection Agency subsequently concluded that no imminent health risk existed.

Some experts questioned the validity of the agency's study because it included only samples the team could collect within 20 minutes, rather than samples collected over 18 to 24 hours. The team found an abnormally high level of particulates. "Soldiers may become concerned because they find soot in their nostrils," they conceded, but the smoke was "only an irritant and a nuisance." For the long term, though, scientists needed to know more about the composition of the smoke to determine the potential health hazards. Meanwhile, at the request of the Deputy Assistant Secretary of Defense for Environment, a special health-risk assessment team from the Army Environmental Hygiene Agency conducted a 60-day study. The agency coordinated its effort with the Environmental Protection Agency's interagency assessment team to exchange information and prevent duplication of effort.

At the request of President George Bush, the administrator of the Environmental Protection Agency, William K. Reilly, traveled to Kuwait in June to assess environmental damage from the Iraqi invasion. "The horrors endured by the people of Kuwait and the unprecedented level of intentional environmental destruction," Reilly reported, "remind us all that there is still evil in the world." He praised the "environmental sensitivity" of the soldiers he met. "One of the untold stories," he added, "is the dazzling performance of the Army Corps, which essentially jump-started the infrastructure of a county." The military, he informed Secretary of Defense Richard Cheney, had greatly assisted scientists working in Saudi Arabia and Kuwait and those responsible for sewage treatment and pollution control. Upon his return, Reilly reported that the environmental damage was not as great as predicted. He cited the interagency team's finding that the levels of sulfur and heavy metals in the air were not abnormally high. Environmental groups, however, questioned those findings.

On 2 June, Kuwait resumed oil production in an offshore field, averaging 130,000 barrels a day. Later that month, it began producing 30,000 barrels a day onshore. On 25 July, Kuwait announced that for the first time since the Iraqi invasion it would resume exporting crude oil, though only on a small scale. Half of the oil fires had been extinguished. Firefighters were snuffing out more than six fires a day. By November 1991, all of Kuwait's oil wells had been capped. On 6 November, the emir attended a ceremonial capping in the Burgan field of the final oil well. The Kuwaitis, delighted to see the end of this tragic and costly episode, celebrated the event as a national holiday.

Kuwait lost more than 1 billion barrels of oil (or 1 percent of its sole natural resource) as a result of the Gulf War, but its huge reserves escaped lasting damage. The country still retained 10 percent of the world's crude oil reserves. With assistance from the U.S. Army and the dedicated, skilled private contractors, the Kuwaiti government had extinguished the oil fires and recapped the wells in record time.

Note: The above article is from a new book, "*After Desert Storm: The U.S. Army and the Reconstruction of Kuwait,*" by Janet A. McDonnell. The book, a joint publication by the U.S. Army Corps of Engineers and the U.S. Army Center of Military History, is scheduled for distribution in the spring of 1999. To obtain a copy, write to: U.S. Army Corps of Engineers Publications Depot, 2803 52nd Avenue, Hyattesville, Maryland 20781-1102.

Records of references used in the article are available in the research collections of the Office of History, U.S. Army Corps of Engineers, 7701 Telegraph Road, Alexandria, Virginia 22315-3865.

All photographs by Jonas N. Jordan, U.S. Army Corps of Engineers, Savannah District.

Janet A. McDonnell, chief historian at the Defense Logistics Agency, previously served as senior historian with the U.S. Army Corps of Engineers. She holds a Ph.D from Marquette University.

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Maneuver Support Center (MANSCEN)

MANSCEN Update. New facility construction is more than 80 percent complete, and some new buildings and ranges have been turned over to the Fort Leonard Wood installation. The Chemical Defense Training Facility will undergo surety training and inspections during the 2nd quarter of FY99.

Schoolhouse organizations are reorganizing to the MANSCEN structure, with adjustments to office space scheduled for completion by May 1999. Most Engineer School personnel will keep their current telephone numbers after they move. Job vacancy lists have been published by Fort Leonard Wood's Civilian Personnel Advisory Center (CPAC), and the selection of personnel to vacancies is ongoing. The Garrison Command Reception Plan is initiating sponsorship and reception activities. POC is Mark Premont, -6134.

Engineer Personnel Proponency Office (EPPO)

DA Pam 600-3. The Chief of Staff, Army, approved the new DA Pam 600-3, *Commissioned Officer Development and Career Management,* on 4 August 1998. It is scheduled for publication on the U.S. Army Publication and Printing Agency (USAPPA) homepage (http://www-usappc.hoffman.army.mil) in November. Distribution of paper copies is scheduled for December.

The Engineer Chapter in DA Pam 600-3 experienced one significant change during the staffing and approval process. Based on a decision by the Combined Arms Center (CAC) commander, the Engineer Training Support Battalion's Executive Officer (XO) and Operations Officer (S3) positions are no longer considered branch-qualifying for engineer majors. POC is MAJ Dave Hartley, -4087.

Department of Training and Doctrine Development (DOTD)

Field Manual Update. FM 5-116, *Engineer Operations: Echelons Above Corps*, and FM 5-415, *Fire-Fighting Operations*, are at the Army Training Support Center awaiting printing. FM 5-116 is a revision of the 1989 edition, and FM 5-415 is a new publication. These manuals are posted to the Engineer School's Publications Page at: http://www.wood.army.mil/PUBS/pubs.htm.

The following manuals are scheduled for publication and release to the field within the next 180 days:

- FM 5-34, *Engineer Field Data*
- FM 5-436, *Paving and Surfacing Operations*
- FM 5-434, *Earthmoving Operations*
- FM 5-472, *Materials Testing*
- FM 90-13-1, *Combined Arms Breaching Operations*
- FM 20-3, *Camouflage*

POC is Sandra Gibson, -4100.

Directorate of Combat Developments (DCD)

Tool Kit Upgrades. Prototypes for the revised Masonry-Concrete Tool Kit (LIN W44923), Electrician Set #1 Tool Kit (LIN W36977), Pipefitter's 1/8" to 2" Pipe Tool Kit (LIN W49033), and Pipefitter's 2-1/2" to 4" Pipe Tool Kit (LIN W48622) were reviewed by subject matter experts at Fort Leonard Wood in October. The tool kits were showcased at the Soldier Review at Fort Benning, Georgia, and are available for viewing at intraservice school sites at Sheppard Air Force Base, Texas, and Gulfport, Mississippi. These upgrades follow the upgrade of the carpenter tool set. The new kits will provide soldiers in the General Engineering Career Management Field with industry-standard tools and high-technology devices comparable to those used in the commercial construction industry. Although the focus remains on construction in a theater of operations, these sets will enable soldiers to complete new construction projects and perform maintenance on existing structures across the spectrum of conflict. POC is Alan Schlie, -6191.

Lead the Way

By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School

Tell It Like It Is

Much has been written about the Department of the Army's enlisted centralized promotion selection board process and how soldiers can successfully compete. While the process is familiar to all of us, after-action reports written by the Armor/Engineer Panel reveal some disturbing trends. A review of these trends follows.

1. Many noncommissioned officers (NCOs) do not spend enough time in key leadership positions – specifically as squad leaders for promotion to sergeant first class, as platoon sergeants for promotion to master sergeant, or as first sergeants for promotion to sergeant major and appointment to command sergeant major. No other positions can substitute for these key and challenging leadership experiences. It is critical that NCOs serve in these positions for a minimum of 18 months, but more time is better, and it is best to serve in several different squads, platoons, or companies. *Nothing* takes the place of sufficient leadership experience. Also, NCOs should not spend too much time in tables of distribution and allowances (TDA) positions and should avoid back-to-back TDA assignments. A proper balance of TDA and tables of organization and equipment (TOE) experience is best. Every NCO should also perform well in one of the following positions: drill sergeant, recruiting, Active Component/Reserve Component (AC/RC) duty, equal opportunity duty, Inspector General duty, Reserve Officer Training Corps duty, or as an observer/controller at a combat training center.

2. Many engineer Noncommissioned Officer Efficiency Reports (NCOERs) do not properly state the ratees' performance and potential. "Excellent" blocks *must* be fully substantiated with well-written bullet comments. Raters and senior raters must do a better job of quantifying and qualifying the performance and potential of the NCOs they evaluate and avoid personal opinions. For example, instead of "Best squad leader I have ever seen" write "Best squad leader in my platoon." Instead of "Led from the front" write "Improved the squad's average PT score by 25 percent." Instead of "Physically fit" state "Scored 275 on the Army Physical Fitness Test." State facts about the ratee's ability to train his soldiers, maintain his equipment, and care for his soldiers. Senior raters must be specific about the NCO's potential. For example, write "Must select for promotion to master sergeant" or "Promote ahead of peers."

Raters must evaluate subordinates thoroughly and fairly. Everyone is good, but a few are "best." If the senior rater does not identify the best squad leader in his platoon or the best first sergeant in his battalion, someone else will make that decision based on what they think was intended in the NCOER. Be specific—write "Best squad leader in my platoon" or "Best first sergeant in my battalion." Tell it like it is. Senior raters must inform Army leaders about the truly great NCOs. There is room to promote only the best so don't allow the promotion board to second-guess you. They may not make the right decision.

3. Some NCOs forget the importance of military schooling. We know that the NCOES schools are a must for promotion. Remember that the Battle Staff course, the First Sergeants' course, and the Defense Equal Opportunity Management Institute are important for NCOs who serve as an operations or intelligence sergeant, a first sergeant, or in an equal opportunity position. The Airborne, Master Parachutist, Air Assault, Master Fitness, and Sapper Leader Courses are important for those serving in a unit and position requiring that knowledge.

4. Civilian education also is important. It improves NCOs' written and oral communications skills and develops their intellect. In today's Army it is not acceptable for an NCO to stop at a general education development or high-school diploma. NCOs must progress further to successfully compete with their peers. All NCOs have time during their careers to acquire civilian training. Be a self-starter! Your post education center will help you select a program that meets your needs.

5. Some NCOs have photos in their DA files that are more than 5 years old. Army Regulation 640-30 states that a new photo is required every 5 years or when the photo no longer represents your appearance. The regulation allows certain members of the chain of command to order a soldier to get a new DA photo, so it is a chain-of-command issue. It is a good idea to get a new photo every time you are promoted. That practice sends a signal to board members that you care about your records and career. Take a buddy along when you are photographed to ensure that your uniform fits properly and looks good and that all awards and decorations are placed correctly.

6. Many NCOs fail to thoroughly review their records and DA microfiche before the promotion board meets. NCOs must review the microfiche to ensure that all documents on it are theirs and that it includes all documents favorable to them. All of your NCOERs, college transcripts, orders for awards, letters and certificates of appreciation, and favorable documents allowed by the regulation should be on the microfiche. Thoroughly check your DA Forms 2A and 2-1 for accuracy and neatness. Ensure that these forms are complete and that they represent you correctly. The degree of interest you show in your record will pay big dividends at promotion time.

Leaders at all levels should ensure that all their subordinates who compete for promotion have reviewed their records and that their records and photos are up to date. It is the right thing to do.

Additional information on promotions is found in the Engineer Center Command Sergeants Major home page (http://www.wood.army.mil/ECCSM/index.htm) or the Engineer Personnel Proponent Office home page (http://www.wood.army.mil/EPPO/eppo_hp.htm). The proponent guidance document that is sent to the promotion board's Armor/Engineer Panel is posted on the home page along with the review and analysis memorandum, which is the board's AAR. Use this information to help you and your subordinates at promotion time. I wish you good luck.

ARMY VALUES

RESPECT

"Without a feeling of respect, what is there to distinguish man from beast?"
Confucius, ANALECTS - 6th Century B.C.

18th Engineer Brigade Construction, Operation Provide Comfort

Following Operation Desert Storm, soldiers from the 18th Engineer Brigade were called upon to provide humanitarian assistance to the Kurdish people of northern Iraq in Operation Provide Comfort. An important consideration for constructing facilities was that they be appropriate to the Kurdish lifestyle. Cultural and religious considerations were more important than any "engineering efficiency." This was true for all construction even for sanitary facilities. The engineers of the 18th knew as others before them that respect for the culture of the people was often the key ingredient to success in nation building, civic action, or humanitarian relief. Almost 30 years before Operation Provide Comfort, an engineer in Southeast Asia noted that the key to success in foreign assistance was to establish bonds of trust and respect between the engineers and those they sought to help.

History Office, U.S. Army Engineer School

PIN: 076852-0

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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

2 3 1999

March 1999

DEPOSITORY
APR 0 9 1999
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Support Operations

Headquarters, Department of the Army
PB 5-99-1 Approved for public release, distribution is unlimited

CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

These are exciting times for engineers as we approach the new millennium. This year has been designated the "Year of the Maneuver Support Center" (MANSCEN) here at Fort Leonard Wood. During the next eight months, the Military Police and Chemical Schools will complete their moves from Fort McClellan to Fort Leonard Wood. The collocation of the Engineer, Military Police, and Chemical Schools under MANSCEN creates a world-class joint training facility for soldiers, sailors, airmen, and marines. MANSCEN maximizes resources, establishes a framework for integrated training, creates synergy among the branches, and promotes joint service training. Approximately $220 million worth of new buildings and ranges, which will increase both the quality and quantity of training conducted here on post, are nearing completion. We continue to serve as a showcase for TRADOC's base realignment initiative. In an era that requires cohesive joint operations among the services in response to crises around the world, we continue to define TRADOC's slogan "Where tomorrow's victories begin."

General Reimer's visit to Fort Leonard Wood in January went very well. He viewed Initial Entry Training activities and ongoing construction in support of MANSCEN, and he received a briefing covering TRADOC's support to Homeland Defense. At the conclusion of that briefing, General Reimer approved Fort Leonard Wood as TRADOC's Center of Excellence for Homeland Defense. The center will "stand up" on 1 October 1999 and take advantage of the synergy created by the collocation of the three schools under MANSCEN.

Why establish this center at MANSCEN? Because—

- It is ideally located and organized to support DTLOMS (doctrine, training, leader development, organization, materiel, and soldiers) integration requirements.
- No other installation brings subject matter experts, training, and battle lab facilities together as well as Fort Leonard Wood.
- It exemplifies the kind of synergy we sought when MANSCEN was formed.

The Homeland Defense mission is to develop and integrate doctrine, training, and materiel requirements in support of the newly formed Rapid Assessment and Initial Detection (RAID) teams, which were authorized and funded in the FY99 defense bill. These teams will operate in direct support of civilian first responders, and each falls under the command and control of the adjutant general of the state in which the team resides. The ten teams being fielded across the United States are aligned with the Federal Emergency Management Agency (FEMA) regions. In addition, the 7th Military Support Detachment RAID team is being activated and will reside at Fort Leonard Wood. It was designated a pilot program by the Army Chief of Staff and must be fully mission capable no later than January 2000. An article describing the Homeland Defense mission and the RAID teams will be published in the April 1999 issue of *Engineer.*

The regiment continues to work on redistributing Bradley fighting vehicles (BFVs) to engineer battalions that support mechanized and armored divisions. It is desirable to have engineers in armored vehicles that provide the same degree of mobility, protection, and survivability as that provided on the maneuver platforms they support in the close fight. Currently we are attempting to retain BFVs in the 588th Engineer Battalion, 4th Infantry Division. The retention of BFVs in the 588th will provide an experimental baseline to further refine doctrine, tactics, techniques, procedures, and organizational designs in the future. A white paper justifying the need for BFVs appears on page 11.

This year's ENFORCE Conference is scheduled for 25 April-1 May. The 1st Brigade is planning to present another outstanding tactical twilight tattoo in celebration of our engineer history. I'm sure it will be a highlight of the conference. The theme for this year is "Joint Engineers: America's Total Engineer Force for the Next Millennium." Mark your calendars; we hope to see you here at Fort Leonard Wood.

Engineer

March 1999 Headquarters, Department of the Army **Volume 29 PB 5-99-1**

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

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***Front Cover:** Engineers from A Companies, 20th and 40th Engineer Battalions, 1st Cavalry Division, reinforce a damaged timber trestle bridge with an AVLB at Base Camp Demi, Bosnia-Herzegovina. Photo by Captain Dan Dolwick, U.S. Army Engineer School.*

***Back Cover:** Historical example of the Army value "Selfless Service."*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER's e-mail address is: eubanksc@wood.army.mil. Our Internet home page is located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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Mine Warfare and Counterinsurgency: The Russian View

By Lieutenant Colonel (Retired) Lester W. Grau

The Soviet Army trained and prepared for a "Third World War." This war would involve large-scale nuclear exchange and/or conventional maneuver, where modern, fast-moving armored forces probe for enemy weak spots, break through enemy defenses using massed or nuclear artillery strikes and the shock action of armor, and then drive deep into the enemy rear area to fight the deep operation. While this vision may still apply to a future war, military theorists in the Russian Ground Forces are considering their last two large-scale conflicts—in Afghanistan and Chechnya—and drawing some conclusions about other possible types of future war.[1]

Soviet military theorists envisioned war on the rolling plains of northern Europe or in the high Manchurian plains near China. Instead, their last two conflicts were fought in rugged mountainous terrain against irregular forces. One conflict occurred on the soil of a neighboring country, and the other was fought on Russia's own territory. Instead of swift wars of maneuver and massed combat power, those conflicts were protracted civil wars that were fought in mountains, forests, and cities.

While armies must train and prepare for the most dangerous future conflict, they should also train and prepare for the more likely future conflicts. Some Russian military theorists think their armed forces are more likely to fight guerrilla or local wars than world wars. The force structure, weapons, equipment, tactics, training, and military theory required to counter an insurgency or fight a local war differ from those required for a world war. As Russian military theorists gather data and develop tactics and methodologies to fight local wars and counter insurgencies, one of their interests is to prepare sappers and other forces to deal with land mines in these conflicts.[2] The applications of land mines in world wars, local wars, and guerrilla wars are distinct and different. The following discusses the Soviet/Russian experience with land mines in Afghanistan and Chechnya and lessons they learned from those conflicts.

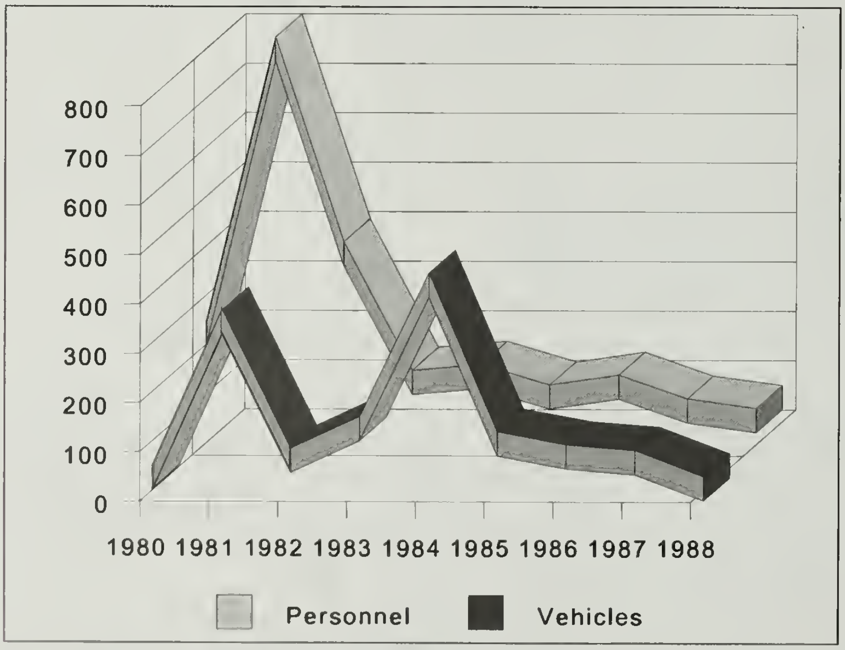


Table 1. Soviet 40th Army losses to mines—personnel killed in action and vehicles destroyed[5]

Afghanistan

Mines are used differently in guerrilla wars than in conventional wars. Whereas the Soviet 40th Army used millions of land mines in Afghanistan to protect communist installations and deny the mujahideen use of their lines of communication, the mujahideen used their limited number of mines more selectively and probably more effectively. The mujahideen antitank mines ranged from homemade to a variety of foreign-designed and -manufactured mines. These designs included the Soviet TM-46, the Italian TC-2.5 and TC-6.1, the U.S. M19, the British Mark 5 and Mark 7, and the Belgian H55 and M3 antitank mines. Their antipersonnel mine inventory was primarily Soviet PMN, POMZ-2, and MON-50 mines but also included the Italian TS-50, the U.S. M18A1, and the British P5 MK1. Many of these mines were manufactured in Pakistan, Iran, Egypt, and China.[3]

Mine Effects

Table 1 shows the Soviet 40th Army's personnel and vehicle losses to mines during their war in Afghanistan. As shown, the mujahideen did not have many mines when the war started but soon obtained them. Soviet deaths to mines initially were high until they developed countermeasures to cut their losses. Their countermeasures included issuing flak jackets, sandbagging and reinforcing vehicle floors, and riding on top of armored vehicles. Dissemination of these countermeasures was part of the in-country training conducted by the 45th Separate Engineer Regiment.[4] After these countermeasures were implemented, the number of deaths from mines fell but the number wounded by mines rose. Vehicle losses spiked in 1984 and 1985 during the heaviest fighting in the war and fell as the Soviets prepared to withdraw.

Table 2 shows the number of mines captured by the Soviet 40th Army as well as the number detected and disarmed or destroyed. The Soviets captured far more mines before the mujahideen could deploy them than they found during mine-clearing activities.

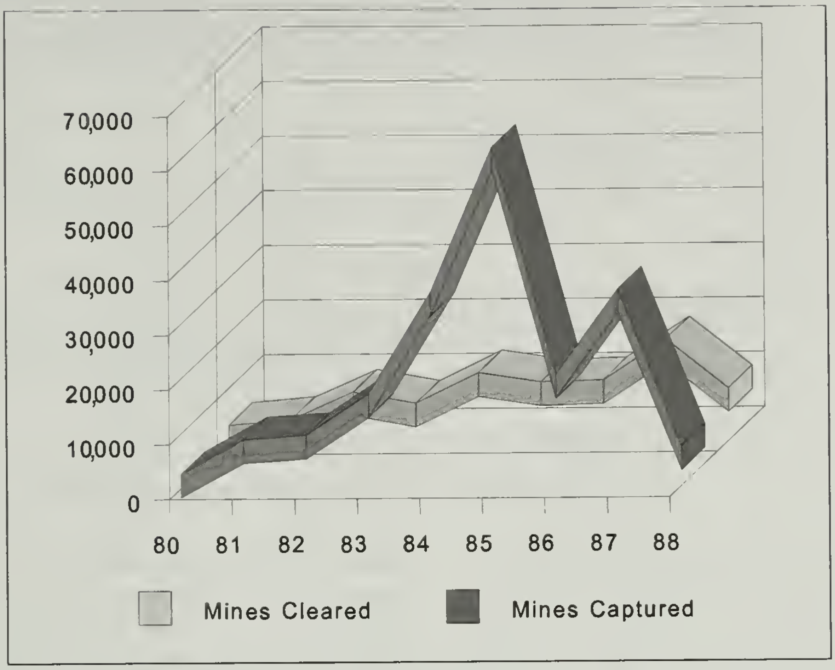


Table 2. Number of mujahideen mines cleared and captured by the Soviet 40th Army, 1980-1988.[6]

Soviet Wounded

Of the 620,000 Soviet personnel who served in Afghanistan, 14,453 were killed or died from wounds, accidents, or disease. That is 2.33 percent of those who served. An additional 53,753 (8.67 percent) were wounded or injured.[7] In the early part of the war, twice as many Soviet soldiers were wounded by bullets as by shrapnel, but by the end of the war, 2.5 times as many were wounded by shrapnel as by bullets. The percentage of multiple and combination wounds increased about four times over the course of the war, while the percentage of serious and critical wounds increased two times. Land mines were the primary reason for the increase in serious and critical wounds. The number of soldiers wounded by land mines increased 25-30 percent over the course of the war.[8] Table 3 reflects this change. The first two lines of the table total 100 percent. For the percentage of single wounds, subtract the percentage of multiple and combination wounds (line 3) from 100 percent. For the percentage of light and moderate wounds, subtract the percentage of serious and critical wounds (line 4) from 100 percent.

During the early years of the war, the mujahideen guerrillas had rifles but few mortars or land mines. As the war progressed, guerrillas captured or re-ceived these weapons and, consequently, the type and nature of wounds changed. Soviet medical evacuation techniques improved during the war, enabling more critically wounded soldiers to survive. The figures in Table 4, which show the number of war dead and wounded for the Soviet 40th Army by year, reflect their improved evacuation techniques.

As the table indicates, the ratio of dead to wounded Soviet soldiers

Type of Wound	1980	1981	1982	1983	1984	1985	1986	1987	1988
Percent from bullets	62.2	54.7	50.4	46.0	34.1	36.6	31.8	26.5	28.1
Percent from shrapnel	37.2	45.3	49.6	54.0	65.9	63.4	68.2	73.5	71.9
Percent of multiple and combination wounds	16.0	21.1	29.5	47.6	65.4	72.8	68.8	65.8	59.4
Percent of serious and critical wounds	23.1	27.7	31.1	47.1	52.4	51.4	50.2	50.1	45.2

Table 3. Type and severity of wounds as a percentage of total hostile fire and mine wounds[15]

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Dead	86	1484	1298	1948	1446	2343	1868	1333	1215	759	53
Wounded	-	3813	3898	6024	4219	7786	8356	7823	5008	3663	144

Table 4. Soviet 40th Army war dead and wounded in Afghanistan, 1979-1989[15]

Location of Wound	1980 (percent)	1988 (percent)
Cranium and brain	4.9	8.5
Backbone and spinal cord	0.1	0.9
Face and jaw	1.4	1.9
Eyes	1.3	3.2
Otolaryngologic (ear, nose, and throat)	1.8	3.4
Chest	11.6	6.3
Stomach and pelvis	7.8	4.6

Table 5. Location of wounds by percentage over time[15]

improved over time from roughly 1:3 to 1:5, with an overall ratio of 1:3.6. By comparison, the Russians state that the ratio of dead to wounded U.S. soldiers during the Vietnam War was 1:5.[9] Despite the increased severity of wounds, more wounded Soviet soldiers survived. Changes in medical procedures apparently improved the soldiers' survivability rate.[10]

Changes in the location of wounds reflect the acquisition of modern armaments by the guerrillas. Table 5 shows the location of the wounds and their percentage of frequency for the first and last full years of the war. The increase in head and neck injuries is consistent with shrapnel injuries from mines and mortars and matches the increase of these types of weapons in the mujahideen's arsenal. The table is incomplete—the source provided general figures of wounds to upper extremities of 25.4 percent, to lower extremities of 37.9 percent, and for thoracic and abdominal wounds of 1.7 percent, without reference to any change over time. Still, figures in the table reflect an increase in injuries that is consistent with those caused by shrapnel from mines and a decrease in wounds to the chest, stomach, and pelvis. The decrease probably is due to enforced wearing of flak jackets and the issue of some improved flak jackets.

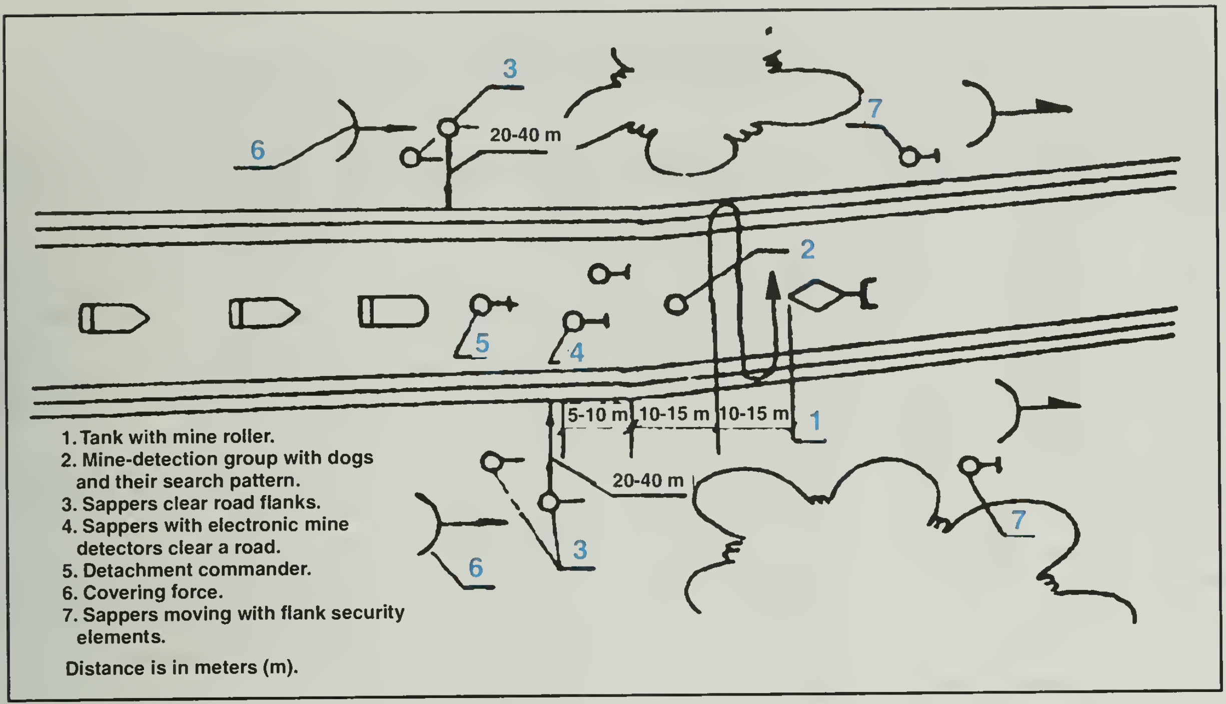
Table 6 compares the percentage of wounds by location for the Great Patriotic War (Soviet soldiers wounded in their war with Germany during World War II), Vietnam (U.S. wounded), Afghanistan (Soviet wounded), and the fighting in Chechnya (Russian wounded). Differences in the percentage of wounds by location partly reflect the type of terrain on which each war was fought, the training and skill of the combatants, and the type and degree of individual protection available.

Chechnya

From the beginning of the conflict in December 1994 until the summer of 1995, Chechen forces seldom used mines against the Russian forces. In July or August 1995, Chechen forces began using mines regularly and they continued to use them until the end of the conflict in 1996. The Chechens did not employ many conventional mines but improvised them using artillery rounds, aviation munitions, grenades, and other explosives. They also employed captured Russian mines, including directional mines, which they mounted off the ground to explode on the flanks or above vehicles and personnel. Most of the Chechen mines were laid on or

Location of Wound	Great Patriotic War (Russian)	Vietnam (United States)	Afghanistan (Russian)	Chechnya-1995 (Russian)
Head and Neck	19	21	15.7	24.4
Chest	9	5	12.2	8.6
Stomach	5	18	7.1	2.3
Pelvis	-	-	3.8	1.6
Arms	30	20	26.3	27.3
Legs	37	36	34.9	35.8

Table 6: Percentage of wounds by location in various wars[15]


3
20-40 m
6
7
2
5
4
5-10 m
10-15 m
10-15 m
1
20-40 m
3
6
7
1. Tank with mine roller.
2. Mine-detection group with dogs and their search pattern.
3. Sappers clear road flanks.
4. Sappers with electronic mine detectors clear a road.
5. Detachment commander.
6. Covering force.
7. Sappers moving with flank security elements.
Distance is in meters (m).

Contemporary Russian formation for clearing roads

adjacent to roads and highways.[11] As a result of their experiences in Afghanistan and Chechnya, the Russian sappers have developed new techniques for clearing roads in a counterinsurgency. Descriptions of some techniques follow.

Russian Road-Clearing Techniques

A Russian motorized rifle regiment normally is given responsibility for clearing roads. If the entire regiment will physically move on the road, the regiment constitutes a movement support detachment (OOD—*otryad obespecheniya dvizheniya*), which includes a tank with a mine roller, a sapper squad mounted on a BTR (wheeled personnel carrier), and scouts and mine-clearing personnel. The OOD moves in front of the regiment and clears the road. If the regiment is responsible for clearing and securing a portion of a road on a long-term basis (such as protecting lines of communication in Afghanistan or Chechnya), the Russians deploy a mine reconnaissance detachment to check the section of road that the regiment maintains. The mine reconnaissance detachment normally consists of a tank with a mine roller, a sapper squad mounted on its BTR, and a covering force mounted on two or three BMPs (tracked armored personnel carriers). As they move, the tank uses its main gun to blast any suspicious objects, such as piles of trash or burned-out vehicles. The sappers must be particularly alert in areas where the enemy might employ command-detonated mines. After the regiment's section of road is cleared, the regimental commander reports this fact to his higher headquarters. No convoy movement is allowed on the road until all commanders have reported that their sections are cleared.[12]

So-called "green zones" were a constant source of trouble in Afghanistan. A green zone is an agricultural area of gardens and vineyards that is bisected by a network of irrigation ditches. In Afghanistan, green zones provided concealment for guerrilla forces and were practically impassible for vehicles. The green zones in many parts of the country bordered highways and provided optimum sites for ambush. Antitank mines, antipersonnel mines, and command-detonated mines were easily concealed in the edges of green zones, where ambush parties and snipers preyed on dismounted scouts and sappers.

The Russians now recommend the formation shown in the figure above for clearing roads. A tank or BMP pushing a mine roller moves in front of the formation. On its flanks and slightly ahead move dismounted motorized riflemen and sappers with electronic mine detectors, who clear snipers and ambushes. The mine detection group, equipped with mine-detection dogs, follows some 40 or 50 meters behind the tank. They carefully look for mines on the road and road shoulders. Sappers with electronic mine detectors move on the road about 15-20 meters behind the mine-detection group. Walking on the right and left sides of the road, two or three sappers with electronic mine detectors and mine probes clear an area about 20-40 meters on the flanks of the road. A covering force of dismounted motorized riflemen follow the sappers who clear the flanks. The BTR and BMPs follow the dismounted party and the mine reconnaissance detachment commander (usually a platoon leader), who controls the activity from the middle of the formation. The average clearing speed of such a formation is about two kilometers per hour.[13] The vulnerability of the sappers to snipers and ambush in Afghanistan and Chechnya was a problem for the Soviets/Russians. This formation protects the sappers with both dismounted infantry and vehicle-mounted direct-fire weapons.

In addition to using dogs, electronic mine detectors, and probes, Russian sappers are taught to look for signs of soil disturbance, soil discoloration, dents or depressions on the earth's surface, and other signals. Such signals include tunneling, broken branches and debris, trash associated with mines or demolitions, trip wires, wire leading away from the site, patches in road work, loose cobblestones, or other indications of mining.

When a member of the detachment finds a mine, the detachment stops and the finder marks the mine's location with a small red flag. The detachment commander and an experienced sapper move to the site and examine the mine. If the commander decides to destroy it, every member of the group draws a circle on the ground where he is standing and marks it with the first letter of his last name and whatever else is necessary to find it again. All the members except the one-man demolition party then move behind the armored vehicles or into a ditch for protection. The demolition party places an electrically primed charge on the mine, moves to a safe location, and detonates the charge. After the mine blows up, group members return to their last location and resume the search.[14]

If the commander decides to disarm the mine, a single sapper is given the mission. He carefully examines the area within a radius of at least 1.5 meters around the mine for other mines, trip wires, or detonator wires. Then he carefully scrapes the concealing layer off the mine; exposes the sides of the mine; and looks for antilift devices, other mines underneath the first, and booby traps. He removes the mine fuze and uses a grappling hook and rope to pull the mine from the hole. He then examines the hole to check for additional mines. Disarmed mines are collected for destruction or evacuation.[15]

The Dangerous Road Ahead

Although international efforts are underway to ban the use of mines in future conflicts, they will remain a constant feature of insurgencies. Mines are cheap, easy to manufacture and deploy, and provide an effective countermeasure to a modern, mechanized force. Guerrilla forces often operate outside the parameters and without the protection of international law. Thus, a guerrilla force may find that the efficacy of mines outweighs their prohibition by international treaty—particularly if the guerrilla force does not represent the state and is not signatory to the treaty.

Countering mines increases the logistics burden on a force—from the necessity to carry additional equipment and clearing personnel to the need for additional medical and mortuary services. Mines that wound rather than kill are more efficacious since every wounded soldier ties up many support and medical personnel. Mines also rob a modern mechanized force of its high-speed mobility and reduce the rate of movement to the speed of a cautious sapper. For these reasons, the problem of countering mines will remain a constant for armed forces well into the next century.

Consequently, modern armies should train to deal expeditiously with mines placed by irregular combatants. If a modern army is not trained to deal with this form of mine warfare, it may, like the Soviets and Russians, find its tempo reduced to that of a cautious dismounted sapper picking his way through rough country controlled by indigenous guerrillas.

Mr. Grau is a military analyst at the Foreign Military Studies Office at Fort Leavenworth, Kansas. He is a Vietnam combat veteran, retired infantry lieutenant colonel, and Soviet Foreign Area Officer. Mr. Grau holds a master's degree from Kent State University.

Endnotes:

[1] This article follows the convention that "Soviet" refers to the period before the breakup of the Soviet Union in 1991 and "Russian" refers to the period after the breakup.

[2] Adam Nizhalovskiy, "Na dorogakh Chechni" [On Chechnya's roads], *Armeiskiy sbornik* [Army Digest], January 1997, page 27.

[3] Russian General Staff material currently being translated for a book by the author.

[4] Petr Antonov, "Chemu uchit opyt" [What does experience teach?], *Armeyskiy sbornik* [Army Digest], January 1997, page 35.

[5] Aleksandr Lyakhovskiy, *Tragediya I doblest' Afgana* [The tragedy and valor of the Afghanistan veteran], Moscow: Iskona, 1995, Appendix.

[6] Ibid.

[7] G. F. Krivosheev, *Grif sekretnosti snyat* [The secret seal is removed], Moscow: Voyenizdat, 1993, pages 401-405. A portion of this article is taken from "Handling the Wounded in a Counter-Guerrilla War: The Soviet/Russian Experience in Afghanistan and Chechnya" by Lester W. Grau and William A. Jorgensen, published in *U.S Army Medical Department Journal, January-February 1998.*

[8] E. A. Nechaev, A. K. Tutokhel, A. I. Gritsanov, and I. D. Kosachev, "Meditsinskoe obespechenie 40-I armii: Tsifry I fakty" [Medical support of the 40th Army: Facts and Figures], *Voenno-meditsinskiy zhurnal* [Military medical journal, hereafter *VMZ*], August 1991, page 4.

[9] P. G. Brusov and V. I. Khrupkin, "Sovremennaya ognestrel'naya travma" [Modern bullet- and shrapnel-induced trauma], *VMZ*, February 1996, page 26. The Russian source of U.S. statistics is unknown.

[10] Readers interested in the medical treatment of mine casualties are directed to "Guerrilla Warfare and Land Mine Casualties Remain Inseparable" by Lester W. Grau, William A. Jorgensen and Robert R. Love, *Army Medical Department Journal,* October-December 1998, pages 10-16.

[11] Nizhalovskiy, pages 27-29.

[12] Mikhail Firsov, "Nepisanye pravila" [Unwritten rules], *Armeyskiy sbornik* [Army digest], January 1997, page 30.

[13] Firsov, page 30.

[14] Ibid., pages 30-31.

[15] Ibid.

Engineer/Civil Affairs Teams Enhance Peace Support Operations

By Lieutenant Colonel Christopher J. Toomey and Major William R. Buckley Jr.

Whether the mission is to deliver humanitarian aid in Somalia, foster development of democratic institutions in Haiti with the United Nations force, or ensure peace and stability in Bosnia as part of the NATO Implementation Force/Stabilization Force (IFOR/SFOR) engineer and civil affairs (CA) units are necessary for successful peace support operations.

This article describes how engineer and CA units can develop positive working relationships and enhance their contributions to any mission. Included are examples of successful operations and some guidelines to maximize these units' combined capabilities.

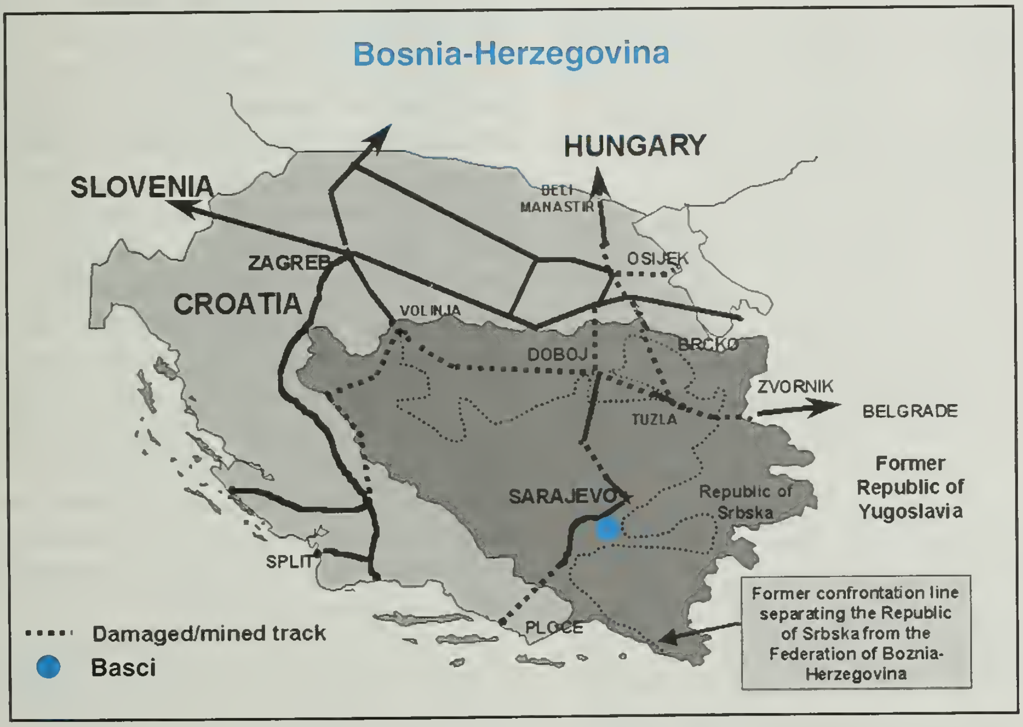
The Challenge

A significant challenge in many peace support operations is that they occur in areas with an immature or destroyed infrastructure. Transportation networks are either rudimentary, as in Somalia or Haiti, or destroyed, as in Bosnia. Utilities often are disrupted or deficient. The lack of a supportable infrastructure limits sustainment of the peace support force and hinders humanitarian aid, economic regeneration, and the development of democratic institutions.

Another challenge is that military forces within peace support operations normally operate in conjunction with the host nation; with governmental agencies, such as the Department of State; or with nongovernmental organizations, such as the World Bank and the European Union. These organizations often are not affiliated with the United States and may have objectives and time lines that are not in synch with military forces. Therefore, fostering stability is a continual and complex challenge during peace support operations. In nations with shattered economic and democratic institutions, the peace support force is often charged with encouraging stability and restoring democratic-based "normalcy."

Complementary Capabilities

To counter these challenges, engineer and CA units bring complementary capabilities to the peace support "battlefield."



The Bosnian rail situation in January 1996

Engineer forces perform valuable service during peace support operations.

Engineer Units

Engineers are infrastructure experts. They provide military forces with mobility and survivability support, particularly during early stages of an operation. Engineers open and construct roads; restore bridges, airfields, and heliports; and open lines of communication. Depending on the force package, specialized well-drilling, quarrying, and other units are included.

Engineer units have design and project management capabilities that are valuable to civil organizations. Engineers can take the lead in demining programs. Depending on the situation, they may remove mines to support military forces and assist civilian demining programs.

Civil Affairs Units

Civil affairs units also bring a wealth of expertise to the theater. These units are concentrated within the U.S. Army Reserves. CA units have personnel skilled in a myriad of professions, skills, and occupations, some of which are not available within the Active Component. Civil and electrical engineers, telecommunications specialists, doctors, veterinarians, farmers, and lawyers are some of the skills that CA units bring to the force.

CA units typically are task organized to support specific mission requirements. Their mission and force structure depend on the degree to which military forces are required to operate in-country institutions. Support can range from a complete "hands-on" approach, similar to that required in Germany and Japan after World War II, to liaison and coordination with existing governments, similar to operations in Bosnia. CA units in Bosnia provide military forces with essential coordination with host nation governments, government organizations, and non-government organizations. Liaison officers are stationed with key players, such as the host nation, U.N. organizations, and the World Bank. Where appropriate, these soldiers provide NATO and the organizations to which they are attached with information on one another's operations, goals, and objectives. They are conduits for information flow in both directions and can build interpersonal relationships needed to coordinate between organizations with no formal connections and that may answer to national authorities with differing goals and priorities.

Mutual Support

Engineer and CA units should support each other during peace support operations and execute combined initiatives. Military engineer resources and efforts normally are focused on direct support to the combined/joint team and have a distinctly military flavor. CA personnel can serve as a lubricant to facilitate this engineer work. Engineers seldom work in a vacuum during peace support operations, so it is necessary to establish and foster relationships with local contractors, host nation governments, and various international organizations working in the area. The CA personnel serve as liaison officers, open lines of dialogue, and represent the command's position. Their liaison skills may be especially helpful when establishing long-term rapport with host governments to facilitate military engineers' access to real estate and locally controlled resources.

CA personnel can also provide economic and political analyses. As engineers develop courses of action, CA forces can provide assessments and projections that facilitate the military decision-making process. Country studies and infrastructure assessments can be very helpful and should be considered valuable resources.

Engineers can support CA operations. Direct support may take many forms but normally is in terms of engineer assessments and design work. A good practice is to include engineers as part of CA assessment teams for infrastructure surveys. These engineers contribute technical expertise and ensure that the surveys support engineer efforts. When resources are scarce, engineers may also provide physical support. A small amount of engineer effort, such as grading a road or rebuilding a wooden bridge, can pay great dividends. CA teams can maximize the use of such residual engineer effort by identifying low-cost, high-payoff targets.

Examples

The authors acquired firsthand experience in exercising engineer/civil-affairs cooperation while serving with the SFOR, NATO Headquarters, in Sarajevo, Bosnia-Herzegovina. The Combined Joint Engineer (CJENGR) and the Civil-Military Commission (CIMIC) Task Force routinely cooperated to facilitate engineer support to SFOR military operations and CA reconstruction objectives as a means of promoting economic regeneration.

Operating in teams, CJENGR and CIMIC personnel established strong liaisons with each other and coordinated both plans and operations. The CJENGR was a multinational organization, while the CIMIC Task Force was a U.S. organization that worked through the multinational CJ9 (the staff section responsible for civil-military operations). For numerous reasons, it was not practical to simply integrate a CIMIC brigade into the NATO headquarters. This was a potential problem, because U.S. civil-military doctrine is much more defined than that of most of our NATO allies. To enhance cooperation, the chief of CJ9 allowed the CIMIC Task Force to pursue missions within the overall SFOR and civil-military campaign plans. For the most part, CJENGR worked directly with the CIMIC Task Force's Joint Civil Commission (JCC). The JCC comprised the bulk of engineer and infrastructure expertise within the CIMIC Task Force.

A primary component of success was ensuring that the engineer and civil-military campaign plans were synchronized with the theater campaign plan and with each other. The engineer campaign plan listed three primary goals:

- Support military operations.
- Promote effective demining.
- Improve civil infrastructure.

The last two goals correlated directly with CA actions. Engineers were major contributors to the CA planning process, while CA personnel participated as members of the CJENGR-led SFOR Infrastructure Steering Group. The steering group brought many agencies together to establish theater-wide engineer policies and construction priorities. Within the steering group, the CIMIC Task Force provided the civil perspective to an organization that had no civilian component. The task force also provided the NATO engineer officers, who had minimal contact with civil-military operations, with resources they could access through their CIMIC teams.

A Hungarian engineer works on the bridge at Basci.

Of major importance to the success of operations in Bosnia was the network of liaison officers the CIMIC Task Force established with the host nation and various international organizations such as the World Bank. The liaison officers helped facilitate engineer initiatives, identify potential high-payoff projects, gain access to resources, and promote engineer activities.

The CJENGR staff routinely consulted with the CIMIC Task Force and appointed a liaison officer to serve as the primary point of contact for CA actions. Working through the Engineer Plans Office, this officer oversaw coordination of engineer support to CA initiatives.

Three initiatives portray the outstanding mutual support fostered at theater level and illustrate the varied scope of engineer/CA actions undertaken: the bridge replacement program, the strategic rail program, and the Basci village construction.

Bridge Replacement Program

Situation: From 1995 to 1997, to promote freedom of movement for military forces, SFOR and its predecessor, IFOR, installed numerous NATO-owned military equipment bridges to replace bridges destroyed on main supply and movement routes throughout the country. In late 1996 and early 1997, international organizations began funding the repair or replacement of damaged or destroyed bridges to replace the NATO military equipment bridges. The challenge was to facilitate bridge repair and replacement—a major move toward economic regeneration—while maintaining full freedom of movement for SFOR. The CIMIC Task Force, which focused on developing civil institutions, un-hesitatingly endorsed the proposal. However, CJENGR, ever mindful of military requirements to keep routes open for military traffic, insisted that all routes remained open. The solution exemplifies the cooperative approach between the two organizations.

Solution: Convinced that civilian-led bridge repair was the eventual long-term solution, the CJENGR considered bypasses for each of the bridges, which would ensure full freedom of movement for SFOR once the military equipment bridges were removed. Since no NATO funding existed to upgrade bypass routes, the CIMIC Task Force coordinated with international donors to incorporate bypass upgrades in their funding. The CIMIC Task Force and the CJENGR worked closely with local transportation directorates to ensure that construction schedules meshed with the CJENGR's ability to remove the equipment bridges and provide site clearance. By working together, the CJENGR and the CIMIC Task Force took this process a step further. They worked together to select sites to place bridges displaced by new construction. Most of these sites had great civil benefits and helped enhance SFOR's image as a positive force within the country.

Strategic Rail Program

Situation: Before the conflict, rail was the primary mode of long-distance transportation in the Balkans. The conflict destroyed much of the rail system (*Engineer*, July 1998, pages 2-6) however, and by 1996 rail traffic was only 15 percent of prewar levels. Large stretches of the network were literally torn apart. In particular, there was no rail access to the mineral-rich Tuzla Valley. Before the war, this area was linked to the Sava River port of Brcko and to ports along the Danube in Croatia and Hungary. In a region with an estimated 70-percent un-employment rate at the start of 1997, the CIMIC Task Force estimated that restoring the link between the Tuzla Valley and Europe would immediately create 1,200 jobs and inject a minimum of $4.6 million per annum into the depressed area. Restoring regional economic vitality is a key component of developing stability and fostering democratic institutions. Encouraging rail traffic across the Bosnian-Croatian border was a positive step in normalizing relations within the divided region.

Solution: Over the course of several months, the CJENGR-CIMIC team worked closely with SFOR's political advisor to develop a program to repair most of the main rail line. Following the CJENGR's technical assessment of the line between Tuzla and the Hungarian border, the CJENGR-CIMIC team developed initiatives to repair it. A key element was using the U.S. Agency for International Development (USAID) as a funding source for materials and construction contractors. As a healthy investor in the region, USAID provided funds for the $2.5 million rail-highway bridge at Brcko and pledged more than $2 million for additional work along the line. With the CJENGR's encouragement, the Italian government deployed the Italian Railway Engineer Regiment to construct the line between Tuzla and Brcko using materials provided by USAID. In Croatia, a series of negotiations chaired by the CJENGR-CIMIC team led to Croatian Rail and the Hungarian government repairing much of the line between the Croatian border and Hungary. By late 1997, a serviceable rail line existed from the Dalmatian Coast to the main European line in Hungary. Although some political obstacles still restrict full traffic, the necessary infrastructure is in place.

Basci Village Construction

Situation: The village of Basci, located southeast of Sarajevo near the International Entity Boundary Line, was ravaged and abandoned during the fighting. Due to its proximity to the boundary and the willingness of its residents to return, the United Nations High Commission for Refugees (UNHCR) considered Basci an ideal place to spearhead the refugee-return program. Funding was available from various sources to purchase modular buildings as housing for returning residents. However, routes into the area needed repair, and two small bridges on the road leading to the village were destroyed. Although local contractor support was not costly, it was limited. Using military engineers to do the work was an attractive option.

Solution: Working as a team, CJENGR and CIMIC Task Force representatives, via the CIMIC Task Force's UNHCR liaison officer, scheduled NATO military engineers to repair the 2,100-meter road and construct two military load class 40 bridges of 6.5 and 6.9 meters, respectively. The troops assigned to complete the mission were members of the Hungarian Engineer Contingent. Because NATO funding did not cover the cost of materials (about $8,000), the CIMIC liaison officer obtained funds from the United Nations.

Guidelines

The following guidelines will help maximize engineer/CA cooperative capabilities.

- **Recognize complementary capabilities.** Engineer and CA personnel must be familiar with each other's capabilities and organizations. Since engineer and CA

(Continued on page 38)

Why Engineers Need the Bradley Fighting Vehicle

On July 28, 1997, the U.S. Army Engineer School submitted an operational concept to Training and Doctrine Command to replace the M113A3 Engineer Squad Vehicle with the Bradley – the Engineer Bradley Fighting Vehicle. In October 1998, Major General Flowers asked the school to develop a white paper articulating why engineers need to be mounted in a Bradley, so the entire regiment can speak with one voice. ***Major Darrell Strother,*** *then chief of the Collective Analysis Branch, took the lead in developing the following white paper.*

* * *

The world has entered a period of radical and often-violent change. The threats are more diverse and less predictable. Today's threat vehicles and weapons are more lethal than those available during any other period in our history. Army combat engineers require a modernized squad vehicle to enhance their speed, versatility, and survivability as they provide necessary mobility and countermobility support to maneuver forces during the close fight. The leading contender to assume this modernization role is the Bradley fighting vehicle (BFV). The long-term solution is to codevelop a future engineer squad variant of the future infantry vehicle.

The Army and the methods by which we conduct warfare are constantly changing. Army Warfighting Experiments (AWE), the development of Force XXI, continuing force reductions, and the combat service support (CSS) redesign effort reflect these changes. To support them, the Engineer Regiment has adopted a strategy that shifts from mechanized to armored warfare. The M1-based Grizzly and the Wolverine are the first two examples of implementing this strategy. Both platforms are designed to accomplish their respective breaching and bridging missions while the soldiers on them remain under armor protection.

The Maneuver Support Battle Lab (MSBL) conducted an experiment under the Concept Experimentation Program (CEP) in 1998 to evaluate the BFV. Results from the CEP experiment clearly demonstrate the requirement to find a more mobile and survivable platform for combat engineers than the M113. While the M113 will continue to have a place in the Engineer Regiment, divisional combat engineers must be mounted in the most survivable platform available if they are to ensure the mobility of the offensively oriented Brigade Combat Team (BCT). Today that platform is the BFV.

The Infantry School has already demonstrated improvements the BFV offers in the areas of cross-country mobility, target acquisition, weapons ranges, night operations, and the potential for technology enhancements. The MSBL Bradley CEP demonstrated how the speed, increased armor, and firepower of the BFV allowed combat engineers to work, maneuver, and protect themselves simultaneously. The turret and main gun have proven extremely valuable to combat engineers, and the BFV provides increased commonality, lethality, and versatility to the BCT.

Analysis reinforces the commonality available to the BCT from the engineers' transition to the BFV. Engineer and infantry soldiers are intermixed on the battlefield and often rely on one another for CSS. The nature of Force XXI and the CSS redesign require us to reduce the logistical demand of the force. It is not unthinkable that the ongoing CSS redesign will lead to consolidated support for infantry, armor, and engineer forces. Efficiencies created by equipment interoperability and commonality can markedly enhance the CSS force's ability to sustain the BCT. Just the reductions in the Prescribed Load List and Authorized Stockage List and the increases in BFV mechanics within the BCT will significantly ease the sustainment challenge.

A high degree of lethality is a key requirement of the current and future force, and it involves more than maneuver and the application of firepower. Lethality is obtained from the synergism of force agility, technologically superior weapons, sound doctrine, and realistic training that emphasizes the integration and synchronization of the BCT.

Engineers cannot afford to be the weak link in the combined arms team. New and readily available weapon advancements combined with the vulnerabilities of the M113 exposed during Operation Desert Storm mean that combat engineers are mounted in the most easily defeated vehicle used to conduct the close fight. When engineers are mounted in BFVs, the situation changes completely. The advantages offered by the BFV allow engineers to move as an integrated, survivable member of the BCT and have all the assets necessary for success. Retention of three additional battalions of BFVs in the division during this time of force reduction increases the overall lethality of the force.

The engineer M113 has become distinguishable on the battlefield as a result of fielding such systems as the Bradley linebacker, the command and control vehicle, and the fire support team vehicle. The enemy can easily target our engineers, while friendly forces

(Continued on page 35)

Force-Protection Measures in Bosnia

By Captain Frederic A. Drummond

The lethality of modern and Third World weapon systems makes the future battlefield an increasingly hostile environment, whether during peacekeeping, peace enforcement, or war. For this reason protecting the force should be a commander's number one priority. Have you ever heard or used these excuses when instituting force protection: "I don't have time for force protection," "I don't have enough money or materials for force protection," "I don't have enough personnel to fill sandbags," or "I don't need to worry about force protection, the engineers take care of it." Our soldiers are our most precious asset; we must provide them the best equipment, technical guidance, and leadership when establishing force-protection measures.

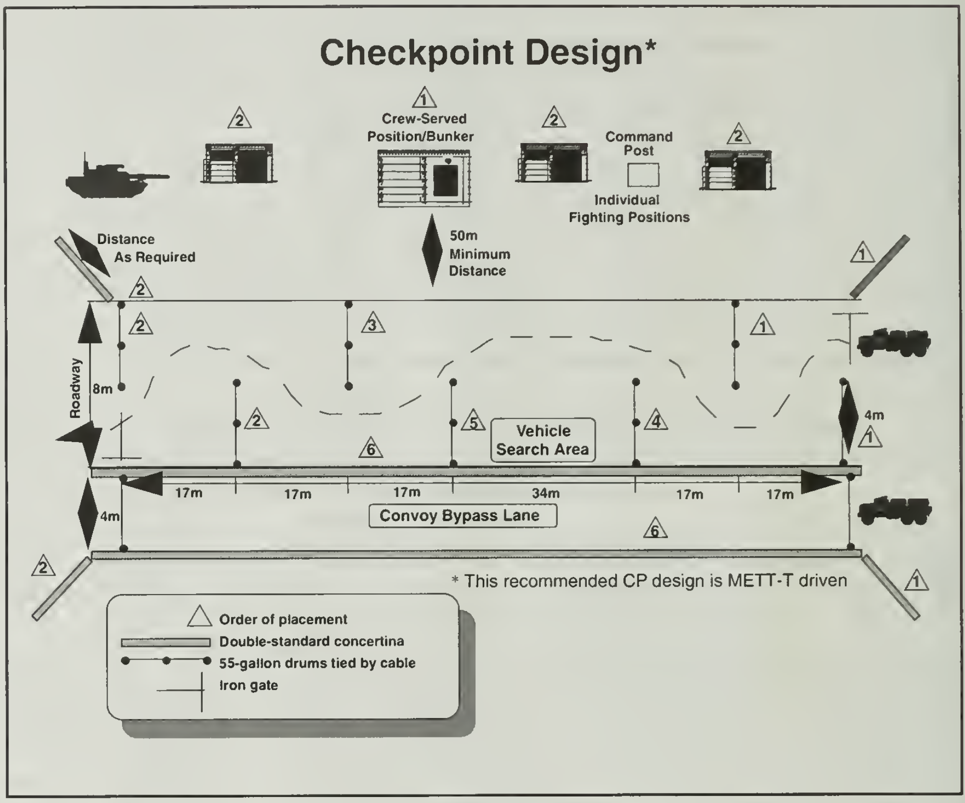


Figure 1

An effective force-protection program consists of both individual skills and collective tasks. Soldiers should be trained continually on force-protection techniques. Since these critical tasks are perishable, they must be sustained through realistic training and evaluated routinely. Leaders should learn force-protection techniques while attending basic and advanced institutional training courses. Understanding the basic fundamentals of survivability and general engineering in peacekeeping, peace enforcement, and war scenarios is essential for all combat arms and combat service support leaders.

This article describes a systematic way to protect soldiers and equipment. It challenges leaders to understand the fundamentals of general engineering as it applies to force protection. We must keep an open mind and be creative when working with force protection.

Force-Protection Measures

Force protection of troop living areas, headquarters elements, weapon storage areas, and communication assets must be considered when planning any operation. Developing force-protection measures begins by educating everyone in the chain of command from the highest to the lowest level. Understanding fundamental procedures—such as requirements for overhead cover, proper emplacement of sandbag revetments, and capabilities of individual and crew protective systems—is essential to ensuring system safety. In most cases, combat engineers do not have the time or the soldiers to construct a base camp and implement force-protection measures for other units. They normally assist maneuver commanders or base camp mayors in formulating force-protection plans. Engineers provide technical and tactical advice and quality control for emplacement of force-protection structures, including earth revetments, wire obstacles, and fighting positions.

A Systematic Approach

During Operation Joint Endeavor, a systematic approach was developed and implemented to monitor force protection in Bosnia. When the operation began, force protection was first on every commander's mind. After the initial thrust of U.S. combat forces into Bosnia, however, it became apparent that most units had changed their focus to completing missions that supported the peace plan.

Task Force Eagle mandated that each unit use three tiers when constructing force-protection systems. The three tiers were part of 1st Armored Division's tactical SOP and were used during several field exercises before Operation Joint Endeavor began. Part of Tier II includes the checkpoint design established by the 1st Armored Division Engineer Brigade (Figure 1). The guidelines were briefed and each unit was expected to meet these standards (METT-T dependent).

Tier I - consists of triple-standard concertina around the base camp, prefabricated fighting positions in place and sandbagged, and established checkpoints.

Tier II - consists of Tier I plus sandbagged protective bunkers.

Tier III - consists of Tiers I and II plus trip flares, guard towers, perimeter lighting, and ballistic protection (fuel farms and helipads).

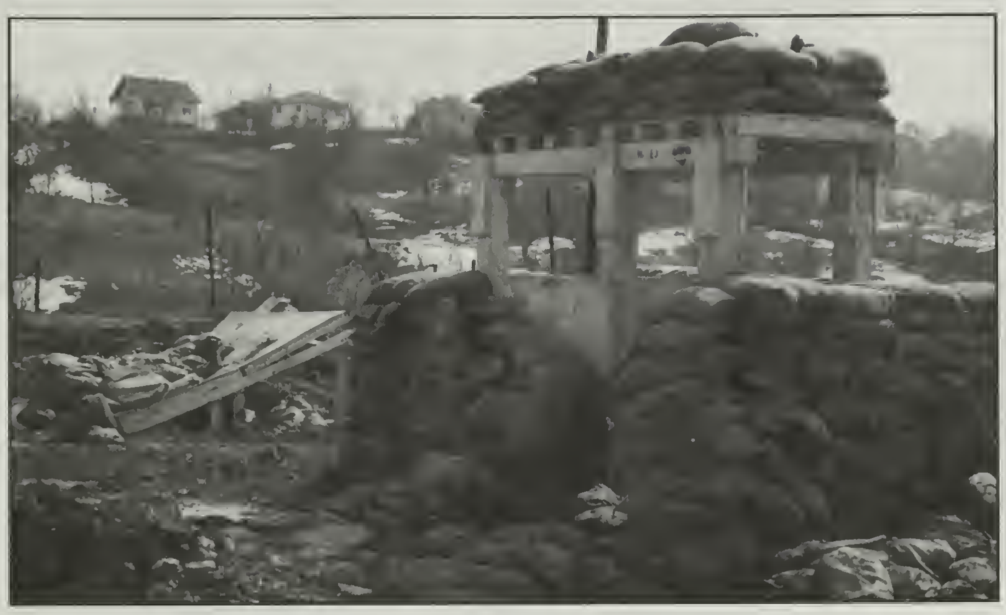
The Base Camp Coordination Team monitored the force-protection tiers. This team worked directly for the Assistant Division Commander for Support and reported its findings monthly. Each engineer battalion reported force protection in its assigned sector to the Engineer Brigade, which then reported to Task Force Eagle. This is a very systematic way to approach and monitor a complex mission.

Bunkers

During the Persian Gulf War, some soldiers were killed when improperly designed bunkers collapsed. The photo above shows a fighting position that collapsed next to a prefabricated constructed fighting position. The fighting position in the background was sandbagged by the tenant unit. When engineers inspected it, they found that it was unsafe. Engineers directed the tenant unit to reconstruct the sandbags, labor that could have been used elsewhere had the bunker been constructed properly initially.

A collapsed protective bunker is a command problem. Before a soldier steps into a bunker system, the chain of command must protect troops by ensuring that the following requirements are met:

- Plan and select sites for fighting positions.
- Properly design, construct, and certify bunkers according to FM 5-103, *Survivability.*
- Provide the correct quality and quantity of construction materials (sandbags, lumber, etc).
- Plan for maintenance and inspect the bunkers periodically.
- Constantly supervise the construction.
- Get technical advice from engineers as required.



This protective bunker collapsed due to improper sandbagging.

During Operation Joint Endeavor, the Army invested considerable money in force protection. Commanders were held accountable for their force-protection status and were required to brief force protection daily. In spite of this command attention, some units installed unsafe fighting positions, checkpoints, and protective bunkers.

Standard Design

When several types of protective systems appeared throughout the Task Force Eagle sector, the Engineer Brigade commander decided to enforce a single standard. Various designs were sent to engineer units and maneuver commanders. Base camp mayors were asked to disassemble all questionable protective systems. The 16th Engineer Battalion was tasked to develop an aboveground fighting position, guard bunker, and protective bunker. Combat engineers, assisted by maneuver commanders and base camp mayors, ordered these protective systems based on their security plan. Engineers delivered protective systems to each base camp and provided technical guidance on the proper subgrade and emplacement. The base camps provided manpower to fill, lay, and tamp sandbags.

Using the "one team, one fight" concept, engineers built safe prefabricated fighting positions, protective bunkers, and guard bunkers and supervised quality control. Engineers inspected each protective system periodically to ensure that the system remained structurally sound and was maintained by the tenant unit. Based on my experience during Operations Desert Shield/Desert Storm and Joint Endeavor, most soldiers are not trained to properly construct fighting positions with sandbag revetments. Failing to tamp the sandbags or laying them incorrectly presents a safety hazard.

Pros and Cons of Consolidated Assembly

Pros	Cons
■ Unity of command and control, with one person in charge (OIC). ■ Continuity and experience improve production. ■ Simplifies supply and logistics coordination. ■ One standard for all products, since each company has force-protection experience. ■ Experienced soldiers increase productivity. ■ Safety, quality control, and quality assurance ensured safe positions. ■ Masses both soldier support and vehicle support (Support Platoon), so no one company suffers the loss of 30 soldiers. This allows companies to continue with other missions. ■ Increases the availability of serviceable tools and equipment. ■ Battalion sets priorities, so there is no question as to where assets go.	■ Not all companies can provide the same soldiers all the time. ■ Depletes resources more quickly. ■ Transportation may not be available to meet production times, and production may stop due to lack of space.

Figure 2

Sandbags

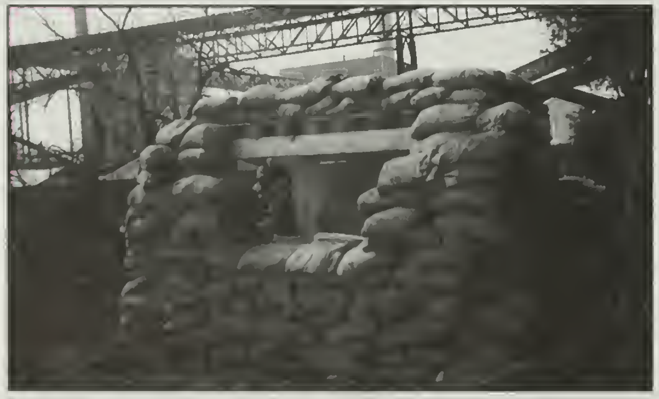
Every leader should use FM 5-103. They must understand the basic fundamentals of sandbagging, which is a key component of the bunker system. The manual describes six steps in sandbagging revetments:

- Turn sandbags inside out. If not turned inside out, they lose strength.
- Fill sandbags three-fourths full with an earth or dry soil-cement mixture and tie the choke ends.
- Tuck in the bottom corners of the bags after they are filled.
- Construct the bottom row of sandbags by placing all bags as headers. Build the sandbag wall using alternate rows of stretchers and headers with joints broken between courses. The top row of the sandbag wall has only headers (FM 5-103).
- Uniformly tamp each sandbag with a flat object (such as a 6x6 board) to force out all air pockets and make the wall more stable.
- Replace sandbags if they are punctured.

The Task Force Eagle commander made force-protection construction the priority for all units because of the underlying threat of terrorism. Task Force Volturno was tasked with the construction and prefabrication of force-protection systems for 12 base camps in the Tuzla Valley and other sites throughout Bosnia-Herzegovina. Each company was responsible for four base camps. It soon became clear that several base camps required large quantities of fighting positions and bunkers. Initially each company constructed its own positions, but with some base camps requiring more than 50 fighting positions, a consolidated production site was needed (Figure 2).

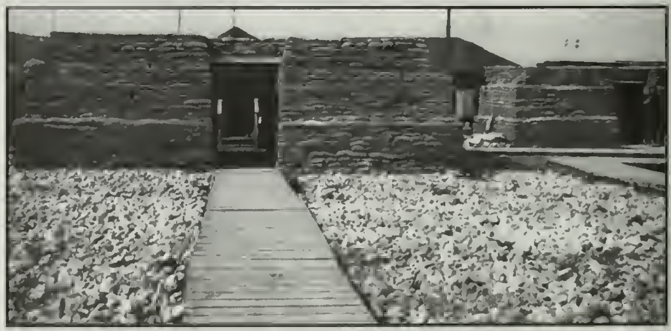
The task of planning, organizing, and constructing this facility was given to Alpha Company, 16th Engineer Battalion. The Assault and Obstacle Platoon established a prefabricated

Poor Bunker Construction



This bunker was not built using the basic fundamentals of sandbagging. Sandbags were laid incorrectly, which presents a safety hazard.

Good Bunker Construction



Protective bunkers located behind the 16th Engineer Battalion tactical operations center at Camp Bedrock. These bunkers present a neat and uniform appearance, and load bearing is equally distributed.

Hesco-Bastion Concertainer Defense

During Operation Joint Endeavor, a new force-protection system was introduced to combat engineers in Bosnia: the British-developed Hesco-Bastion concertainer defense wall system. The concertainer wall sections are constructed from geotextile-lined galvanized wire mesh panels that are connected with a spiral of galvanized wire mesh hinges. When the wall expands, it forms an array of linked, self-supporting cells. When the cells are filled with earth, sand, snow, etc., they provide ballistic and blast protection. Once erected and filled, the cells can withstand a 155-millimeter high-explosive blast detonated from a distance of five feet. To provide flexibility, the wall sections are designed in several sizes. The sections we used were 10 meters long by 1 meter wide by 1.37 meters high.

Applications. Concertainer wall sections can be used to construct—

- Protective bunkers
- Aircraft and headquarters revetments
- Shelter and observation posts
- Fuel points

Advantages. Concertainer wall sections offer the following advantages:

- They require less construction time than sandbags.
- They can be stacked higher than sandbags.
- They can withstand stronger blasts than comparable amounts of sandbags.
- They provide immediate visual protection.
- The containerized system is easy to stack and haul.

Disadvantages. Concertainer wall sections have some disadvantages:

- They are not in the supply system.
- They are hard to recover once used.
- Heavy engineer equipment, such as a bucket loader or a small emplacement excavator, is required to fill the bastions.

Availability. The company can produce 2,100 10-meter sections per week. They are shipped on NATO pallets, five to a pallet.

The Hesco-Bastion concertainer wall system saved engineers a considerable amount of time when implementing force protection in Bosnia. Units deploying on peacekeeping or peace-enforcement missions need a system that is easily deployable and provides sufficient protection for soldiers. The Hesco-Bastion is an outstanding system with many applications.

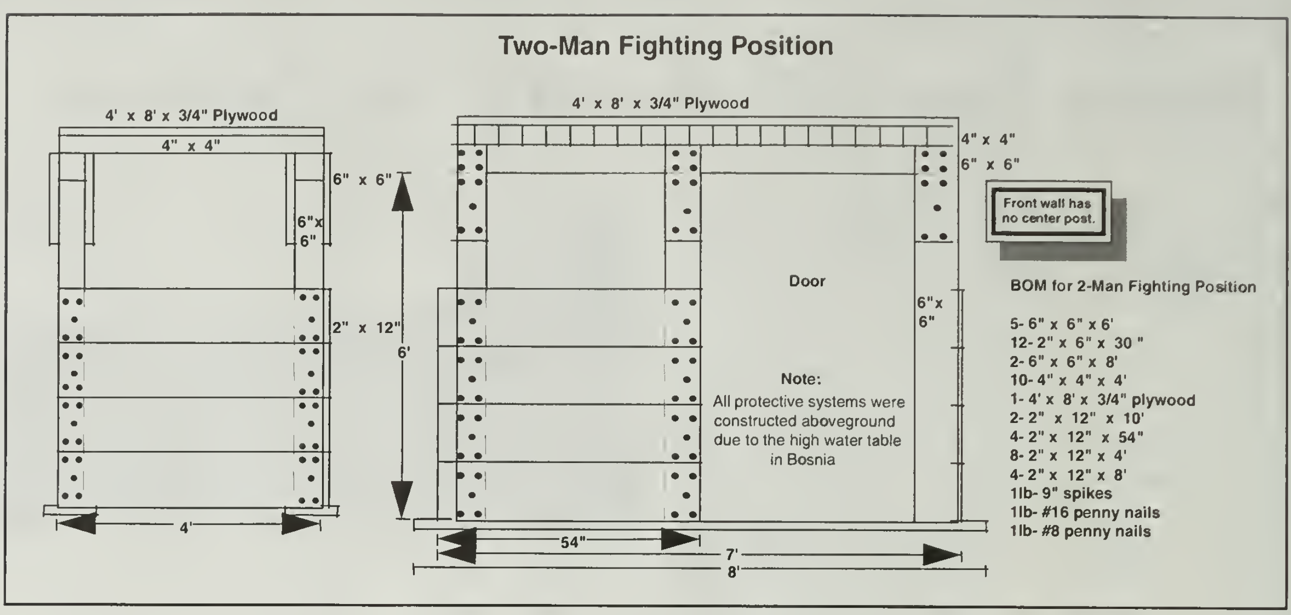


Figure 3

construction yard known as "Slate" on Camp Bedrock, and it began mass producing force-protection systems. The first phase in the building process was to develop the work site. Due to limited resources, two medium tents were used. The construction site was divided into four areas:

- Download and storage
- Ripping and cutting
- Prefabrication
- Assembly and rough cutting

Each area was run independently and simultaneously. With the building area construction complete, "Slate Construction" was born, and the next phase began. The need for rapidly available, quality force protection required 24-hour operations. Each company in the task force supplied five soldiers, who worked in two 12-hour shifts with 15 soldiers per shift. We established four teams, each run by the same NCOIC to ensure continuity. Alpha Company supplied the NCO foreman for each team, and the other companies rotated soldiers through due to their mission requirements. The teams were—

Haul team—one NCO and two soldiers with one or two HEMTTs with forklifts. The team hauled wood from the S4 yard to the assembly area, coordinated with the S4 to obtain materials, and delivered fighting positions to the site or helped the support platoon load them.

Ripping/cutting team—consisted of two NCOs to operate saws and two soldiers to carry wood. The team had two circular saws, but a radial arm or table saw would have been helpful. The team cut wood for the prefabrication operations, ensured that the standard template for cutting was followed, provided quality control for cutting operations, and determined the cutting order and overall control operations.

Prefabrication team—consisted of one NCO and three soldiers. The team assembled fighting position components, constructed walls and roofs, and moved prefabricated parts to the assembly area.

Assembly team—consisted of one NCO and two soldiers. The team assembled the fighting positions and packaged them for shipment.

The materials used to construct the fighting positions and bunkers varied significantly. The battalion S4 requested the required lumber, but dimensions often varied due to the many suppliers. Most of the cutting and assembly was done in the cutting and prefabrication tents. Because of their size, bunkers were assembled outside in the assembly area. Initially the priority went to fighting positions (Figure 3), but as base camps became more secure, personnel bunkers became more important.

Do It Right

Before any protective system is constructed, officers and NCOs should attend a class given by the engineer team supporting their base camp on proper emplacement procedures. During Operation Joint Endeavor, we found that most leaders had no idea there is a systematic way to lay sandbags, build bunkers, or use Hesco-Bastions (see page 15) to augment sandbagging. After officer and NCO training, there was a noticeable improvement in the placement, uniform appearance, and structural soundness of the sandbag revetments. Teach leaders first, then the soldiers, and never accept a substandard sandbag wall. The lives of our soldiers depend on it.

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Engineers, Army After Next, and Military Operations in Urban Terrain

By Jeb Stewart

The Army After Next (AAN) project is a series of studies on future warfare that frame issues vital to the development of the U.S. Army. The studies are in formats suitable for integration into TRADOC combat developments programs.[1] With a 30-year focus, the AAN process begins about 2025 and describes requirements beyond the current Force XXI development. When executing the 1998 AAN campaign plan, futurists focused the force design on "mechanized airmobility." This particular concept was an area of concern for engineers.

Engineers and AAN

The concept of mechanized airmobility envisioned the convergence of air and armor attacks on an objective. The concept described a very fast operational tempo to disrupt enemy coherence. The critical materiel part of mechanized airmobility was a single ground/air combat system, the Aerial Infantry Fighting Vehicle. In this idealized AAN vision, enemy obstacles, inundated areas with low trafficability, and conflict-induced rubble were of little concern because the futurists assumed mechanized airmobility would free maneuver forces from the ground approach to the objective. In this concept, AAN strike forces would simply cross deadly zones by flying over them.[2]

Since their work in articulating the initial concept, the AAN community has determined that the Aerial Infantry Fighting Vehicle was "neither technologically nor operationally feasible."[3] Consequently, the mechanized airmobility concept has been put on the shelf while other organizational structures are examined. This action was a lucky break for Army engineers because, when engineer leaders saw the first papers and briefings, they were appalled at the dismissive intent toward terrain and ground mobility.

For engineers, this aspect of the initial AAN project clearly seemed to be "a stretch" that denied laws of physics. The air mechanization concept could have had a pernicious effect if applied to midterm mobility doctrine, training, leader development, organization, materiel, and soldiers. Since AAN was designed to mesh with TRADOC's requirements determination process, there was ample cause for concern.

Pushing rubble in France in 1944—old-fashioned MOUT.

> **"Future land combat units will exploit terrain by maneuvering for tactical advantage within the folds and undulations of the earth's surface without suffering the restrictions imposed on speed and mobility by contact with the ground when conducting movement or being inserted into a battlespace."**
>
> **"Forging Possibilities into Reality" by**
> **BG Buckley, LTC Franke,**
> **and A. Fenner Milton**
> ***Military Review,* Mar-Apr 1998**

Fortunately, the AAN concept is young and has much room for development. The 1998 Army After Next Report to the Army Chief of Staff indirectly shows that ground mobility concerns have replaced some of the early enthusiasm for mechanized airmobility. From the engineers' perspective, this change is a step in the right direction.

Engineers and MOUT

During AAN war games, one phenomenon emerged time after time and in war game after war game: To avoid certain defeat by the AAN Strike Force, the enemy went into and occupied a city. When that happened, the battle tempo became what General Krulak, Commandant of the U.S. Marine Corps, calls the "three-block battle." AAN operational tempos promptly collapsed, and the initiative went to the enemy. Engineers have always been a key component of the military operations in urban terrain (MOUT) force, and this seemingly unsolvable MOUT dilemma calls for an engineer solution. MOUT situations present a succession of mixed civil engineering and close combat problems. Therefore, the engineer component of AAN looks like a good "mission fit."

Armies traditionally have tried to avoid combat in cities, but in the 21st century we *will* operate in built-up areas. To do so effectively and with minimum casualties and collateral damage, we must enhance our means to apply modern Army XXI engineering skills to a full spectrum of urban situations. Military forces in urban areas may be applied toward a wide variety of missions, including peacekeeping and peace enforcement, combating domestic terrorism and the use of weapons of mass destruction, and evacuating noncombatants. The ability to apply appropriate military force in built-up areas is difficult—a politically astute adversary can rather easily thwart a sophisticated heavy force that is trained and equipped for high-speed maneuver warfare. AAN war games have confirmed this dilemma. To resolve it, engineer operations must be a key element of the decisive military force in urban areas.

The lead for MOUT will remain the purview of the U.S. Army Infantry Center and School, and engineers will support them. Future MOUT operations are likely to include many of the same deliberate, slow, and painstaking tasks performed historically. In past operations, as when U.S. Army forces cleared Japanese troops from Manila in World War II, engineers in combined arms task forces concentrated on mobility and countermobility missions. The engineer component primarily reacted to the immediate needs of the task force. In those operations, engineers were called upon to clear rubble, perform demolition work, create breaches in structures, and repair infrastructure to support military uses. Those same tasks are likely to be important in future operations.

Engineers can and should increase their role in MOUT. By expanding the doctrinal focus to include MOUT, many critical elements of future operations are easily envisioned. Some potential engineer contributions are—

- Applying information technologies, specifically three-dimensional terrain visualization of above- and below-ground structures and infrastructures. Examples include database storage and displays of city streets, power grids, water and sewage systems, manholes, subways, etc.
- Predictive modeling of materials' strengths for precise and measured weapons effects and to establish mobility platforms , i.e., rooftop landing zones.
- Rapid, nonexplosive breaching of walls and similar obstacles for soldiers and equipment.
- Teleoperations and semiautonomous or autonomous clearing of booby traps and mines/munitions using small robots.
- Acquiring and providing targeting information for smart weapons designed to penetrate a designated point within a structure.
- Preparing templates of enemy weapons effects that include predictive structural strengths for friendly survivability.
- Ensuring the use of infrastructure services, such as electricity, water, and transportation hubs, for friendly forces and denying them to the enemy.
- Developing a "tool kit" for combat in cities.

An increased role for Army engineers in MOUT will enhance the convergence of combat, construction, and topographic engineer units and missions. For example, the capability to prepare three-dimensional urban terrain visualization products requires such skills as combat soldiering, civil engineering, city planning, architecture, and the ability to create graphic information systems. A strengthened engineer role in MOUT seems especially well suited for light engineer forces.

Suggested tasks to support an increased role for Army engineers in MOUT follow:

Doctrine. Engineer School personnel develop MOUT-specific tactics, techniques, and procedures for mobility, countermobility, general engineering, and topographic engineering, and provide input to FM 90-10-1, *An Infantryman's Guide to Urban Combat.*

Training. Engineer School personnel identify MOUT-related tasks for unit Mission Training Plans and add MOUT instruction to One-Station Unit Training courses. School personnel develop training to fully utilize Fort Leonard Wood's MOUT facility, which is being constructed for both military police and engineer requirements.

Leader Development. Determine MOUT training needs for engineer officer basic and advanced courses.

Organization. No immediate or direct impacts on organizational structure are identified, but units will consider MOUT training when preparing their Mission Essential Task Lists.

Materiel. The development of equipment specifically for MOUT represents something of a problem. Specialized equipment can save lives, but more equipment leads to higher training and maintenance requirements and, if we are not careful, to heavier burdens for soldiers to carry. We must consider these factors when building our MOUT tool kit. We should examine equipment used by police and fire departments.

Soldiers. Evaluate the "soldier's burden" in MOUT by testing extremity body armor and an appropriate mix of ammunition items. Consider physical factors as well as training overload factors when designing equipment. Think about the old Army joke, "100 pounds of ultra-lightweight equipment."

The following MOUT lessons learned, prepared following the mission to Panama during Operation Just Cause, apply to engineers:

- Engineers should have scheduled opportunities to practice live-fire demolitions and breaching techniques in realistic training situations.
- Engineers should have employed obstacle systems in sewers to hamper enemy use of underground passageways.
- Engineers could have employed claymore mines more effectively in urban situations.
- Engineers should have removed stairways to hamper enemy use.
- Engineers should have reinforced ground floor areas to provide for increased blast protection.

Photograph by Sarah Underhill

Soldiers in a four-man stack outside a building at Fort Benning's McKenna MOUT Training Site.

Looking Ahead

Enhancing the capabilities of Army engineers for MOUT is fully warranted and justified. The trend toward MOUT seems irreversible—the U.S. military's next conflict probably will resemble past conflicts in Hue, Beirut, Belfast, Sarajevo, Mogadishu, and Chechnya more closely than Operation Desert Storm.[4] The Army *must* continue to develop future MOUT capabilities to sustain its reputation as the "world's finest sustained fighting-in-cities force." It is not because we seek decisive engagements in complex urban terrain or want to fight in cities. The reason for developing this capability is simply to deny advantages to and influence the perceptions of a potential adversary. When an adversary realizes that an urban environment offers no benefits and will become the graveyard of his military power, the enemy commander will be inclined to avoid urban areas. Our capability to defeat him in the city must be so overwhelming that we influence his tactical choices. The advantage must be ours. The U.S. Army vitally needs these capabilities, and engineers are a major contributor to this fight.

Jeb Stewart is a military engineer development analyst with the Directorate of Combat Developments, U.S. Army Engineer School.

Endnotes:

[1] "Knowledge and Speed," July 1997 report to the Army Chief of Staff.

[2] Suggested by the article, "Tomorrow's Army: The Challenge of Nonlinear Change," by LTC Antulio Echevarria II, *Parameters*, fall 1998.

[3] Summary Report, Integrated Idea Team on Operational and Tactical Mobility, December, 1997.

[4] From remarks by Secretary of Defense Cohen, cited in *MOUT: the Showstopper,* Proceedings, February 1998.

Bridging Shortfall: Lines of Communication Bridging

By Captain Kevin A. Brooks

> *"... the U.S. Army is not as well equipped as it might be to construct follow-on, long-span fixed bridging. More emphasis is clearly needed in this area to help overcome what could, in a different scenario, be a serious shortcoming."*
>
> *Dr. Martin J. Falk*
> *Science Advisor to CinC USAREUR & Seventh Army*
> *"The Ribbon Bridge in Peacekeeping Operations"*
> *The Army Engineer, August 1997*

During the past 20 years, the U.S. Army has changed from a forward-deployed, defense-oriented force structured around the old NATO general defense plans to a force-projection-based force capable of tremendous strategic and tactical agility. We have endorsed the theory of *maneuver warfare*—the domination of our opponents by obtaining positional advantage and conducting sequential operations at a pace faster than they can implement counteractions. This evolution has been accompanied by development of a wide range of combat systems that make such fast-paced operations possible, including the M1A1/A2 Abrams tank and the M2/M3 Bradley infantry fighting vehicle/cavalry fighting vehicle. The battlefield mobility these systems offer can be decisive on the modern battlefield...*if we can deliver them to, and sustain them on, that battlefield.* Our ability to meet this key requirement is currently deficient in terms of our capability to conduct river- and dry-gap-crossing operations.

This situation is reminiscent of one faced by another generation of engineers in 1939. During the months preceding World War II, new tanks were developed that weighed up to 35 tons, such as the M3 Grant and M4 Sherman tanks. This heavy equipment posed problems for an engineer force that had just replaced its Civil War-era 7 1/2-ton ponton bridges with 10- and 20-ton-capacity bridges.[1] By 1944, increasingly heavy tanks required a 50-ton-capacity structure, which was satisfied by a combination of modified steel treadway floating bridges and Bailey fixed bridges.[2]

The observation in 1939 that "...engineers ...were aware of the inadequacy of their own bridging equipage and acknowledged that they were unprepared..."[3] is as true today as it was then. Engineers know that current tactical bridging systems cannot handle the increased loads of our newest equipment, such as the M1A1/A2, except under "caution" or "risk" category crossings that decrease the crossing rate. None of our systems can handle the M1A1/heavy equipment transporter (HET) combination at military load class (MLC) 96W over any but the shortest of gaps or, for float bridging, at low-stream velocities. We can marginally support a heavy-force river or gap assault crossing, even though it is under restrictions that affect the crossing rate. However, we cannot provide appropriate bridging support to establish and maintain lines of communication (LOC) for continued operations.

Current Status

Doctrine concerning river- and gap-crossing operations is scarce except for information provided for assault crossings in FM 90-13, *River-Crossing Operations*. Rear-area bridging operations are not well explained in any doctrinal publication, although ARTEP 5-145-32-MTP, *Mission Training Plan for the Engineer Bridge Company*, includes a partial doctrinal framework for conducting such operations. Based on this information, gap- and river-crossing operations can be divided into three broad, and sometimes overlapping, categories:

- Assault crossings conducted under close combat conditions maintain the momentum of maneuver forces or initiate offensive operations. The ribbon bridge/raft and the armored vehicle-launched bridge (AVLB) are used to conduct these operations. Beginning in 2000, the AVLB is scheduled for replacement by the Wolverine heavy assault bridge, which has an increased capacity and a longer span.
- Whenever possible, temporary forward fixed bridging (sometimes called "follow-on bridging") replaces assault-crossing equipment remaining in the brigade and division rear areas as maneuver forces advance. The temporary bridging frees the assault assets for future operations. The medium girder bridge (MGB) is our only forward fixed-bridging system.
- Within the corps rear area and communications zone, long-term LOC bridging is installed to support the sustainment effort. The MGB and ribbon bridges are replaced where possible to free assets for use in forward areas. The current LOC bridge, the M2 Bailey, is a widened derivative of the original Bailey bridge procured by the U.S. Army in 1941.[4] The ribbon bridge also can be used. However, its usefulness as a LOC bridge is limited because LOC traffic is predominantly nontactical, the bridge requires extensive anchoring systems and maintenance, and this asset should remain available for assault requirements.

Engineers supporting Task Force Eagle executed the Sava River crossing in Bosnia in December 1995. This operation illustrates the Engineer Regiment's ability to conduct and maintain a crossing on a long-term basis. The maneuver force could cross on the ribbon bridge, although movement was slow due to the bridge's limited capacity to handle the M1A1 (MLC 70T). However, the increased logistical support traffic that followed caused problems because much of it was nontactical and included heavy, multiaxle wheeled equipment. Significant effort was required to modify and maintain the structure to support the increased loads until a second bridge, which allowed two-way traffic, was completed on 17 January 1996.

As the science advisor to the Commander in Chief U.S. Army Europe and Seventh Army stated, "The ribbon bridge was designed to provide a quick means of crossing wet gaps. It was not conceived as a permanent bridge on a main supply route."[5] It would have been desirable to quickly replace the ribbon bridges with fixed bridges, but the MGB and Bailey bridges in our inventory could not replace the destroyed spans. The only solution was to obtain a commercial bridge. The Army procured an advanced panel bridge, a Bailey bridge derivative manufactured by a British firm (Mabey & Johnson). Allowing for the time required to procure this bridge was acceptable in Bosnia, but such a delay could be catastrophic in a high-intensity combat environment.

New Initiatives

The engineer community is aware of our shortfall in bridging capabilities. The ribbon bridge was not designed to handle MLC 70T tanks, much less MLC 96W wheeled traffic. The MGB is limited by its capacity, in terms of span and loading, and its exotic alloy construction. The alloy prohibits significant field maintenance and contributes to metal fatigue problems that require frequent inspections and management of the total volume crossing over structures. The current M2 Bailey system is unchanged from its World War II design and is too narrow to support modern traffic, especially the M1A2/HET combination. Its span and load capabilities are deficient (the almost universally mistrusted cable reinforcement system is unavailable), and the lack of available M3 conversion sets and reinforcing chords precludes panel-pier or multispan construction.

The U.S. Army Engineer School has initiated several programs to remedy our bridging shortfalls. Programs that will impact LOC bridging include the following:

Heavy Dry Support Bridge (HDSB). Currently under development, this $177 million program will provide 32 mechanically erected bridge sets capable of crossing MLC 70T and MLC 96W traffic over gaps of 40 meters. Originally described as a LOC bridge, it has steep ramps and no guardrail, which makes it more suitable for tactical rather than logistical traffic. Depending on funding, initial fielding is projected for the year 2002, with procurement completed in 2010.[6]

Multirole Bridge Company (MRBC). This program involves replacing current MGB and ribbon bridge companies with new, dual-role bridge companies. The interim structure provides each MRBC with MGB and ribbon bridge sets. In the final configuration, these units will be equipped with the HDSB and improved ribbon bridge, with transportation provided by the new common bridge transporter (CBT), a derivative of the HEMTT (heavy, expanded-mobility, tactical truck). Of the 16 MRBCs scheduled for our Total Force, seven will be allocated to the National Guard, five to the Reserve Component, and four to the Active Component. Transition to the interim structure has been hampered by a lack of equipment, especially in the Reserve Components.

Improved Ribbon Bridge. This modified ribbon bridge has an increased capacity (MLC 70T normal, MLC 96W caution) and articulated ramp bays that accommodate bank heights up to 2 meters. This program is still in the feasibility analysis stage of development. It is not optimized for LOC traffic.

Comparison of the HDSB to an Advanced Panel Bridge

DTLOMS	Heavy Dry Support Bridge	Advanced Panel Bridge
Doctrine	Handles M1/HET, MLC 100W/70T at 40 meters; simple span, single lane only.	Handles M1/HET, MLC 100W/70T at 49 meters; multispan/lane capable.
Training	Simplified crew training.	Minimum training required, if familiar with M2 Bailey.
Leader Development	Simplified leader requirements; no construction calculations.	Experienced leaders required; tabular design system.
Organization	Requires 14 personnel.	Requires 60 to 80 personnel, but no more than 30 working at one time.
Materiel	Support required for 9 loads (6 CBTs, 3 palletized load system transporters (PLSTs); mechanical erection.	Requires 12 CBTs or PLSTs or current TOE 05463L MGB/Bailey Company (32 5-ton dump trucks); manual erection.
Soldiers	Requires 1.5 hours to emplace; mechanical erection.	Requires 8 to 12 hours to emplace; manual erection.

When teamed with the pending procurement of the Wolverine heavy assault bridge, these proposed programs eventually will satisfy our assault and forward fixed-bridge requirements. The HDSB, once considered the solution for all our fixed-bridge needs, will replace the now-inadequate MGB system. The question is, how will we meet our forward fixed-bridge requirements until the HDSB is fielded in the 2002-2010 time frame? What happens if the HDSB procurement plan is delayed or cancelled?

Even with the HDSB, our LOC bridging capabilities will remain seriously deficient. The HDSB design is not optimized for the LOC role, and its relatively high cost prohibits purchase in sufficient quantities to meet war stockage requirements. So, how will we address our LOC bridging requirements now and in the future? The Engineer School is preparing an Operational Requirements Document to identify specific needs in this area. But there is an affordable, feasible alternative to a time-consuming and expensive new LOC bridge system development program.

An Interim Solution

U.S. Army engineers need a solution to the bridging shortfall that can be implemented in a timely manner and that does not depend on outside support. Because of procurement time, it took more than three months for the Army to replace the Sava River float bridges with the commercial fixed bridge we were forced to use, and vendor support was required to erect it. One possible solution is to purchase a limited quantity of proven, commercial-off-the-shelf advanced panel bridging to replace the old M2 Bailey systems retained in Reserve Component panel bridge companies. This solution will ensure our ability to conduct limited fixed and LOC bridging operations on short notice without depending on external support.

Army engineers also need to maximize the use of available fixed-bridge assets. There is no need to "reinvent the wheel" to solve this problem when available systems will meet our needs. The proposed solution is economical and makes the best use of limited assets. Commercial-off-the-shelf panel bridge systems that are based on modified Bailey designs and that use modern alloy steels are available from various manufacturers. They have increased roadway widths and longer span lengths at a greater load capacity than the old M2 Bailey bridge systems. NATO and multinational forces in Bosnia have installed 25 advanced panel bridges when the Bailey systems proved to be inadequate. The durability of advanced panel bridges has been proven repeatedly, and they are often used as permanent replacement bridges in the civil sector. Adding these new systems to our four panel bridge companies will provide a source of "in house" LOC bridging expertise that can be used in contingency operations. It will avoid reliance on support from vendors or the Engineer School.

Required Capabilities. A new LOC bridge system requires the following capabilities:

- Sufficient width and load capacity to handle logistical traffic. The defining system should be the M1A2/HET combination, which requires a roadway that is 3.7 meters wide and an MLC 96W.
- Ability to span at least 40 meters at design load capacity (MLC 96W) without using a multistory design. This capability is based on the HDSB requirement. Since NATO requires a capacity of MLC 105W (apparently based on the old British Chieftan MBT and HET), the structure should be capable of supporting this requirement under a "caution" category crossing.
- Minimal specialized training requirements for soldiers experienced in standard Bailey bridge erection.
- Low procurement, operation, and maintenance costs.
- Immediate availability.
- Packaging configuration that supports rapid strategic deployment.

Advanced Panel Bridge. Advanced panel bridge systems meet all of these requirements. Using the Army's standard DTLOMS (doctrine, training, leader development, organiza-

Double story MLC 70T Bailey bridge erected in June 1998 as a temporary replacement bridge at Fort Pickett, Virginia, by the 1031st Engineer Company (Panel Bridge), Virginia Army National Guard.

tion, materiel, and soldiers) model, a comparison of a sample advanced panel bridge system and the HDSB is shown in the table on page 24.[7]

Army engineers must be prepared to support maneuver forces across the entire conflict spectrum, from domestic support to high-intensity conflict. Purchasing a limited quantity of advanced panel bridge sets and providing them to the Reserve Component panel bridge companies ensures an *immediate* interim fixed-bridging capability until the HDSB is fielded. It provides some degree of insurance against delays to that program and a viable LOC bridging capability to complement the HDSB in its forward fixed-bridge role. Because other high-priority engineer systems may compete for very limited funding, program delays are possible (the engineer portion of the Army's research, development, and acquisition budget through FY 2006 is estimated to be only 0.06 percent).[8] For an estimated cost of $8 million, we could equip the four remaining panel bridge companies with advanced panel bridge systems and pre-position 12 additional sets overseas as contingency stockage. This is approximately the same cost as 1 1/2 sets of HDSB.

Reserve Component panel bridge companies are our primary LOC bridging asset. The bridging mission can be trained during weekend drills and, except for individual specialists at the Engineer School, these units are our last source of panel bridging expertise. These units have proved their ability to successfully accomplish this mission during numerous local disaster response and operational support missions. And since they are already our initial response force for domestic disasters, advanced panel bridging will enhance our capabilities in this important area as well. The companies—already manned, trained, and ready—are a potential asset that is being largely wasted because their bridges are inadequate. Revitalizing this asset by acquiring advanced panel bridging offers an economical, practical, timely, and effective solution to our LOC bridging problem.

Repeating History

The bridging dilemma we faced in 1939 was solved in part by procuring the Bailey bridge. It would be a fitting tribute to Sir Donald Bailey and his timeless vision of an efficient, portable bridging system if the solution to our current LOC bridging problem repeats history in the form of an advanced, modernized Bailey system that allows us to accomplish our mobility support mission into the next millennium.

Captain Brooks is the S3, Engineer Brigade, 28th Infantry Division (Mech), Virginia Army National Guard. Previous assignments include S3, 1030th Engineer Battalion, and Commander, 1031st Engineer Company (Panel Bridge), Virginia Army National Guard; and active duty platoon leader and company XO, 13th Engineer Company (CS) and 19th Engineer Battalion (Cbt). CPT Brooks holds a bachelor's degree in civil engineering from Virginia Military Institute.

Endnotes:

[1] Falk, Dr. Martin J., "The Ribbon Bridge in Peacekeeping Operations," *The Army Engineer*, August 1997, p. 38.

[2] Hearings on Military Establishment Appropriation Bill, 1940, HR, 76th Congress, 1st Session, 1 February 1939, p. 393, as cited in *United States Army in World War II: The Corps of Engineers:Troops and Equipment*, by Coll, Blanche D.; Keith, Jean E.; and Rosenthal, Herbert H., USGPO, Washington, D.C., 1975, pp. 36-49.

[3] Coll, et al, pp. 486-497.

[4] Ibid, p. 37.

[5] Ibid, p. 51.

[6] Falk, p. 38.

[6] HDSB data obtained from U.S. Army Engineer School slide presentation on bridging developments provided to the author on 20 December 1996.

[7] See note 6 regarding HDSB data. Compact 200 data courtesy of the manufacturer, Mabey & Johnson.

[8] Allen, James L., "Engineers in the Future Army," *Engineer*, November 1997, p.44.

Army Performance Improvement Criteria Strengthen OSUT and AIT Engineer Battalions

By Lieutenant Colonel Allen C. Estes and First Lieutenant Ricky J. Scott

The Army Performance Improvement Criteria (APIC) process is a method of self-assessment that is an integral part of the Army Communities of Excellence program. APIC is based primarily on Malcolm Baldrige National Quality Award criteria, which are commonly used by America's best corporations to achieve a competitive advantage. The goal of APIC is to establish and maintain a systematic process to review and analyze relevant performance measures against established standards. The focus is on continuous improvement and customer satisfaction. The 35th and 169th Engineer Battalions, from the 1st Engineer Brigade at Fort Leonard Wood, have embraced the APIC process to improve one-station unit training (OSUT) and advanced individual training (AIT) for engineer soldiers.

Mission

The 35th and 169th simultaneously conduct two separate training missions. Each battalion is comprised of three OSUT companies and one AIT company. OSUT companies conduct basic combat training and advanced individual training in a combined 14-week cycle to produce high-quality Career Management Field (CMF) 12 soldiers (12B Combat Engineers and 12C Bridge Crewmembers). AIT companies conduct training for seven engineer military occupational specialties (MOSs) and one ordnance MOS (62B Construction Equipment Mechanic) in CMFs 51 and 63. The engineer MOSs are 51R Interior Electrician, 51T Technical Engineer Specialist, 62E Heavy Construction Equipment Operator, 62F Crane Operator, 62G Quarrying Specialist, 62H Concrete and Asphalt Equipment Specialist, and 62J General Construction Equipment Operator. AIT cycles range from six to 18 weeks.

The APIC Process

Using the APIC process to improve performance, training, and quality required that we answer the following questions:

- How do we know when we have provided adequate initial entry training (IET) to soldiers?
- What core processes determine this baseline, and how can they be measured?
- How do our results compare with those of other Army units that perform the same or similar missions?
- Who are our customers, and are they satisfied with the soldiers we send them?

The APIC process starts with identifying a unit's core processes—those tasks that soldiers must perform well for the organization to be successful. Core processes for OSUT companies are soldier performance in basic rifle marksmanship (BRM), hand grenades, the Army Physical Fitness Test (APFT), attrition, safety, End-of-Cycle Test (EOCT), End-of-Cycle Comprehensive Test (EOCCT), weight control, discipline and motivation, and Army values training. Core processes for AIT companies are soldier performance in the APFT, attrition, safety, weight control, discipline and motivation, Army values training, and MOS course performance. Some of these processes are measured more easily than others.

Many variables other than core processes indicate a unit's performance, including the number of Articles 15 per cycle, barracks quality, field training exercise performance, drill and ceremony scores, cadre APFT results, drill sergeant certification, trainee abuse allegations, post inspection results, sports programs, and award competitions. While these are important, the APIC process focuses on variables that determine if soldiers are trained, disciplined, physically fit, motivated, and ready to make an immediate contribution to their new units.

Several periodic internal assessment mechanisms enable the 35th and 169th Engineer Battalions to continually monitor performance. At the battalion level, cadre after-action reviews, weekly command and staff meetings, weekly training meetings, quarterly training briefs, quarterly reviews and analyses, safety council meetings, and quarterly training status reports play a crucial role in the

APIC process. The 1st Engineer Brigade helps battalions monitor performance by using similar mechanisms at a higher level.

Performance Assessment

Core processes are measured and tracked over time to assess performance, improvement, and trends. Figure 1 shows BRM hit averages from the first quarter of 1997 through the fourth quarter of 1998. A soldier must hit 23 out of 40 targets during record fire to qualify on the M16 rifle. The brigade and battalion goals of 26 and 28 hits, respectively, form a band of excellence that we try to maintain. An average above 28 hits indicates a tremendously successful cycle. First-time "go" and end-of-day "go" rates are tracked as additional performance measures.

Figure 2 shows the final APFT averages over a three-year period. Again, the battalion and brigade goals provide a band of excellence where any average above 240 points is outstanding. The final APFT average tells only half the story. We recently tracked the initial diagnostic APFT averages, which indicate consistent improvement of more than 100 points during the 14-week cycle. Some trends tend to be cyclical. For example, winter classes do not perform as well on the APFT as summer classes, which are filled with recent high school graduates. Winter trainees often shoot better, because classes are smaller and drill sergeants can provide more individual attention. We measure other core processes in a similar manner.

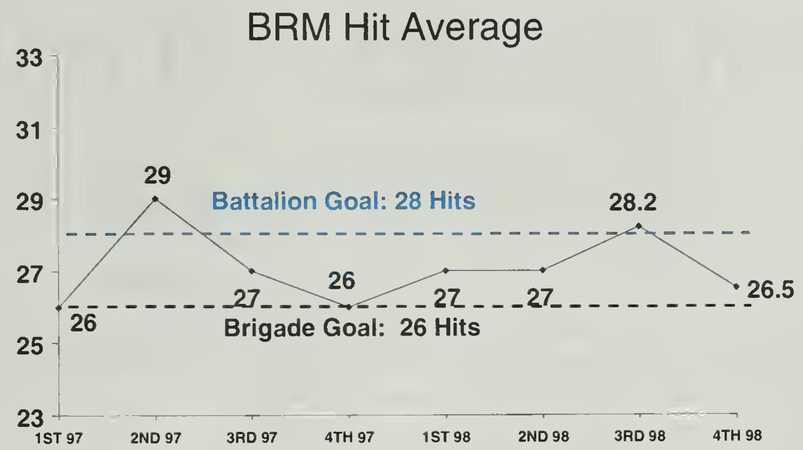


Figure 1

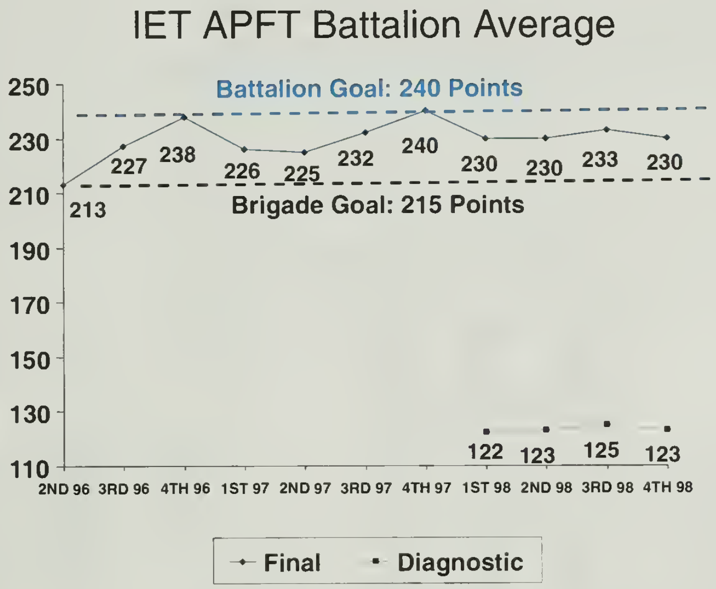


Figure 2

To prevent isolated self-evaluation, APIC requires that units compare their results against other units that perform the same or similar missions. In comparison with armor OSUT units at Fort Knox and infantry OSUT units at Fort Benning, Fort Leonard Wood engineer soldiers attain roughly the same or better results. Comparisons of some mission results are difficult to make, because ranges are different or tests are conducted in a different manner, but the approach is to determine which units perform best and adopt their good ideas.

Customer Satisfaction

Since customer satisfaction is an integral part of APIC, customer feedback is very important. The battalions' internal customers are the IET soldiers they train; their external customers are the active, reserve and National Guard engineer units that receive these soldiers. Internal feedback is provided through trainee sensing sessions, after-action reviews, trainee letters to the commander, and surveys.

Trainee surveys provide the most objective and systematic feedback. Soldiers respond to questions regarding quality of life, the soldierization process, and training. The surveys are organized in question and Likert Scale formats. Figure 3, page 26, summarizes the soldiers' response to quality-of-life issues from the second through the fourth quarters of 1998. Out of 10

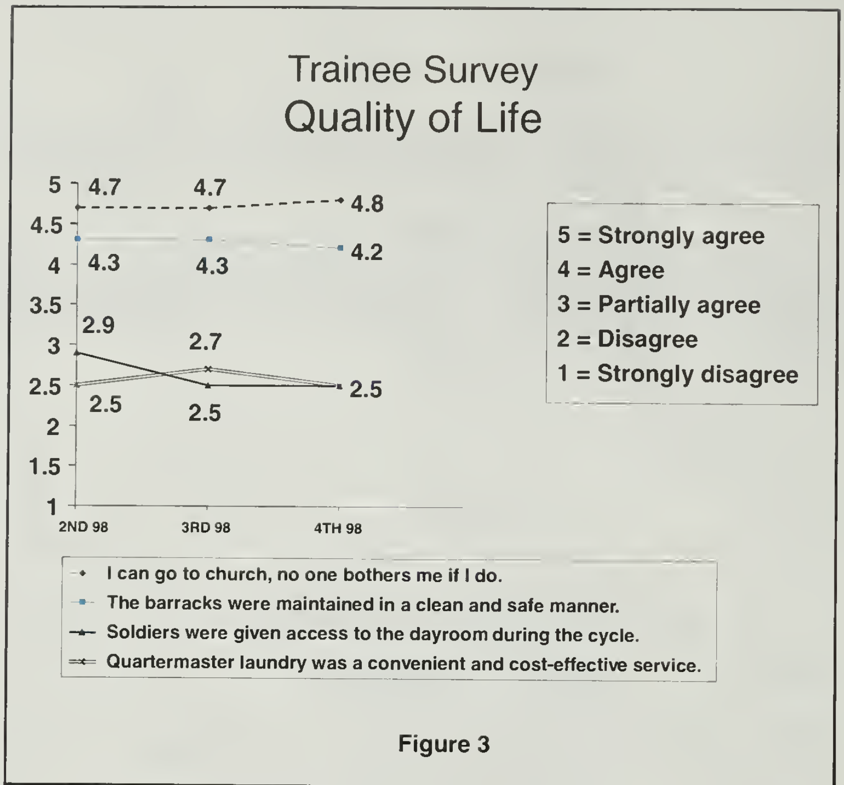
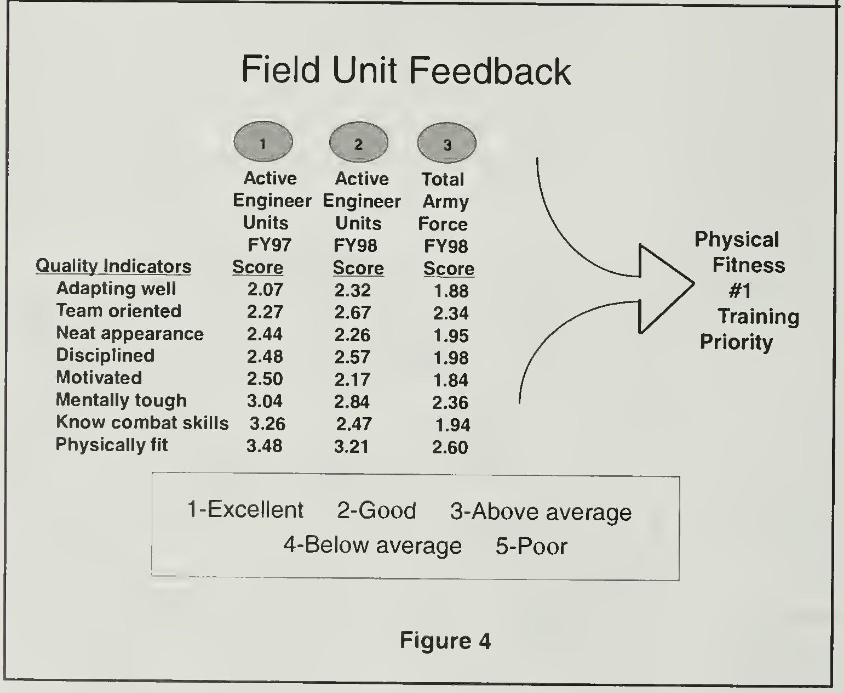


Figure 3



Field Unit Feedback

Quality Indicators	① Active Engineer Units FY97 Score	② Active Engineer Units FY98 Score	③ Total Army Force FY98 Score
Adapting well	2.07	2.32	1.88
Team oriented	2.27	2.67	2.34
Neat appearance	2.44	2.26	1.95
Disciplined	2.48	2.57	1.98
Motivated	2.50	2.17	1.84
Mentally tough	3.04	2.84	2.36
Know combat skills	3.26	2.47	1.94
Physically fit	3.48	3.21	2.60

Physical Fitness #1 Training Priority

1-Excellent 2-Good 3-Above average
4-Below average 5-Poor

Figure 4

quality-of-life questions, Figure 3 shows the two questions that yielded the best and worst responses over time. The numbers ranging from 5 (good) to 1 (poor) mean little by themselves. Comparing the numbers to various other quality-of-life issues over time provides leaders with valuable input on where to focus more effort. Trainee surveys also address areas such as the quality of dining facilities and field chow, quality of medical treatment, quality and quantity of training aids, assessment of safety precautions, training that soldiers like most and least, availability of cleaning supplies, and quality of physical training.

The primary method of obtaining external feedback is through surveys sent to engineer units throughout the Total Army Force that receive our IET soldiers. In 1997, we sent surveys to commanders of all active duty engineer units that receive 12B and 12C soldiers. In 1998, we distributed surveys to all commanders and command sergeants major in the Total Army Force who receive 12B and 12C soldiers. More than 40 percent responded to the surveys each year, and Figure 4 shows the results. Our conclusion is that physical fitness must remain our top training priority.

In 1999, all engineer units with CMF 12 and CMF 51 soldiers will receive surveys. Survey results will be available at the ENFORCE Conference at Fort Leonard Wood in April.

Conclusion

APIC has helped the 35th and 169th Engineer Battalions more accurately measure and improve their performance, but much work remains to be done in this process of continuous improvement. Initiatives for FY99 include additional systematic coordination with other OSUT units for benchmarking; more MOS-related performance indicators for AIT students; including off-site AIT companies in Gulfport, Mississippi, and Shepard Air Force Base, Texas, in the APIC process; and incorporating performance measures for values training and weight control. The APIC process, which incorporates management techniques used by America's top-performing companies, helps engineer training units provide the force with the best possible new soldiers.

Lieutenant Colonel Estes commands the 169th Engineer Battalion at Fort Leonard Wood. Previous assignments include S3, 36th Engineer Group; and S3, 43rd Engineer Battalion. LTC Estes is a graduate of the United States Military Academy and holds a doctorate in civil engineering from the University of Colorado.

Lieutenant Scott is the operations officer for the 169th Engineer Battalion. He is a graduate of the Engineer Officer Basic Course and holds a master's degree in management from Webster University.

Ammunition Forecasting for Task Force Operations

By Captain Jared Ware

At 0130 hours, the task force support platoon leader drives toward the brigade support area. Following chemlights between the concertina wire into the area, he asks the gate guard for directions to the Class IV/Class V pickup point for the task force. The guard points to the south and says, "That way, sir, about 150 meters, right next to the covered HEMTT."

After finding the site, the platoon leader discovers that the Class IV/Class V point does not have the right ammunition. There are no MICLIC reloads on hand and only a few AT4s and Dragons. There are too many high-explosive mortar rounds and not enough smoke rounds. The platoon leader asks the Class IV/Class V NCO why the ammunition count is not what he needs for the upcoming mission, and the NCO replies, "Sir, each task force gets an equal amount of ammunition."

"But our task force is the main effort for tomorrow's attack, sergeant," answers the platoon leader.

"Sorry, lieutenant, but the Brigade S4 gave me the logistics plan, and this is what you get. Besides, you never sent in an ammunition status report."

As the support platoon personnel load the ammunition, the platoon leader wonders why Task Force Eagle received so much ammunition if they are in reserve. He also wonders how he's going to explain the improper mix of ammunition to the task force commander at the morning operations brief.

* * *

This article provides information to fix task-force-level ammunition forecasting problems. It defines ammunition terms and describes how planners can accurately forecast ammunition requirements for combat operations.

Terminology

Ammunition consists of bullets, rockets, demolitions, mines, and associated munitions. Ammunition supply is based on a *required supply rate* (RSR) and a *controlled supply rate* (CSR). According to FM 5-71-3, *Brigade Engineer Combat Operations (Armored)*, page 6-8, the RSR is the estimated amount of ammunition required to sustain operations, without restrictions, for a specific period. The rate is determined by forecasting ammunition requirements based on the mission, enemy, troops, terrain, and time available (METT-T). RSRs are based on weapon density for a given unit. RSRs can be developed by several methods, but the accuracy of the calculations varies from method to method. The CSR is the rate of ammunition that can be supported for a given period based on ammunition availability. If a support unit cannot supply a specific type of ammunition based on the forecasted RSR, then it imposes a CSR to limit the distribution of that type of ammunition. The CSR may be less than the RSR; the optimum situation is when the RSR equals the CSR.

Combat load is the ammunition required by each combat system and the individuals assigned to that system. Also called the *minimum initial issue quantity*, a combat load is a standard measure used throughout the Army and provides the baseline upon which units develop their basic loads. Class V loads can be calculated per system, per individual, or per unit.

Basic load is the command-determined quantity and type of munitions carried by an individual, unit, or combat system. A *unit basic load* is the amount of ammunition needed to initiate combat operations and can be moved in a single load by a designated unit.

Responsibility

In a task force environment, the S3 should forecast and determine ammunition requirements. Slice elements, such as engineer, military police, and chemical units, should provide input to the task force S3 for their specific requirements. The S4 then sources these requirements, which normally are based on the mission, its duration, weapon systems used, and the number of personnel in the task force. The task force S3 often allows the S4 to determine and source ammunition requirements without input from slice elements. When that happens, the elements may not receive the ammunition needed to complete their combat missions. For example, engineers need mine-clearing line charge (MICLIC) rockets and reloads for mobility missions and Volcano munitions for countermobility missions. Field artillery units use 155-millimeter smoke rounds for breaching operations, and they need scatterable mines for defensive missions.

Both FM 5-71-2 and 5-71-3 describe a general concept of Class V consumption but don't provide enough information to actually develop a thorough Class V forecast. FM 5-71-2, *Armored Task Force Engineer Combat Operations*, page 6-4, states that "Class V material is based on reported expenditures submitted to the field trains by the first sergeant." This manual discusses ammunition expenditures, but it only addresses replacing Class V expenditures rather than forecasting mission requirements. FM 5-71-3 is the only engineer manual that discusses forecasting requirements for engineers.

Problems

The problems that planners encounter when forecasting ammunition requirements stem from a number of sources.

- Some planners at the task-force level misunderstand ammunition forecasting. Establishing a unit basic load from a tactical SOP is a good start, but that provides only enough ammunition to initiate a mission, not sustain it.
- Establishing an RSR is difficult due to the forecasting tools available. RSRs often are a "best guess," based on the task force planners' experience.
- Units must prioritize ammunition requirements because the haul capacity at the company level and below is limited. Most ammunition is carried on vehicles organic to the company, such as M1A2 tanks, M2A3 Bradley fighting vehicles, M113 armored personnel carriers, HMMWVs, and cargo trailers.

OPLOG Planner

FM 9-6, *Munitions Support in Theater Operations,* chapter 3, page 1-3, states, "An automated tool called the Operational Logistics (OPLOG) Planner is the authorized method for determining munitions planning data at all levels." It is a good tool for forecasting engineer-specific ammunition requirements and can be used to establish an RSR for engineer ammunition. Based on the mission, the OPLOG Planner creates an ammunition consumption report that shows the type of ammunition required for a specific type of operation, battle intensity, and duration. From this report, engineer planners can forecast ammunition requirements. A simplified version of the process follows:

1. Determine the engineer unit by source reference code (SRC), unit identification code, type, size, and name.
2. Assign the engineer unit a "task force" name such as "203_EN_ BN."
3. Assign the unit to the "task force" by SRC and quantity (type a "1" next to the SRC).
4. Determine the use of mission parameters or custom parameters and modify them.
5. Create an order, such as "Order 1-1," and assign the engineer unit to it.
6. Determine the type of operation, intensity, and number of days for the operation.
7. Select the data according to the area of operation (mission, duration, and posture).
8. Prepare the consumption report and the ammunition report.
9. Print the reports (to a file, screen, etc.) and analyze them according to the mission.
10. Divide by the quantity of weapon systems in the unit (ignore line item numbers [LINs] that are not in the unit).

Mission parameters are based on a number of factors specific to the mission and area of operation. The figure on page 29 shows various parameters for combat operations.

Table 1, page 29, is an estimated ammunition consumption report for an engineer battalion, heavy division. The document lists data such as the mission, intensity, duration, LINs and quantity of weapon systems, and Department of Defense identification codes (DODICs) for associated ammunition. It also lists weights associated with each DODIC as a planning factor for transportation. Table 2, page 30, shows the total ammunition consumption for an engineer battalion in the attack phase. (OPLOG Planner also calculates for defensive and reserve missions.) Although not shown in Table 2, the ammunition report includes the DODIC Summary Report for the engineer battalion, the Phase DODIC Summary Report, the Phase Total Report, and the Order DODIC Summary. These reports are useful if an operation has more than one phase or if more than one unit provides input to the ammunition forecast. The reports also contain information needed to forecast initial ammunition requirements for engineer units in a task force.

OPLOG Planner allows the user to build task force models, which add multiple units to the report. However, planners should analyze the information carefully, because the calculations often produce extremely high consumption rates for units that do not use the amount of ammunition estimated for their combat mission. For example, the program recognizes that all M16A2 rifles in a task force fire at the same rate. This is equivalent to putting an entire task force's M16A2s on line and firing the rifles at maximum rate. To forecast accurately, planners should run the program for individual units and their specific missions rather than "grouping" the units as a task force.

Drawbacks

Although OPLOG Planner is a good planning tool, it has some drawbacks. It—

- Does not forecast for most engineer units below the battalion level. Engineer planners must perform an extra "allocation" step to forecast Class V requirements for an engineer company by separating the company's forecast from the battalion's.
- Does not account for certain types of Class V supplies. Engineer Class V munitions not accounted for in OPLOG Planner include the Modular Pack Mine System (DODIC K022).
- Does not calculate consumption rates for the MICLIC or the MK19 grenade machine gun. It lists the basic loads for these systems but does not calculate additional ammunition requirements for these situation-dependent munitions.
- Generates Volcano consumption rates but lists the individual mine consumption rate instead of the canister consumption rate.

Parameter Set: -> Defense-Succeeding Days-Light	
Description->	Defense: Combat Posture; Succeeding Days; Intensity: Light
Class I->	A: 1, B: 0, T: 1, MRE: 1, LRP-I: N, HCP1: Y, HCP2: Y, R/CW: N
Class II->	Theater: NEA
Class III->	Profile: CONUS
Class IV->	Barrier: Y, Construction: Y
Class V->	Rate: NEA DIV
	Posture: Defense;Succeeding Days; Intensity: Light
Class VI->	Use [Y/N]: N, Climate:
Class VIII->	Echelon: ECH 1 & 2 (DIV), Theater: MRC-W
Water->	Echelon: Division, Climate: Temperate
Parameter Set: -> Protracted-Reserve	
Description->	Combat Posture: Protracted; Intensity: Reserve
Class I->	A: 1, B: 0, T: 1, MRE: 1, LRP-I: N, HCP1: Y, HCP2: Y, R/CW: N
ClassII->	Theater: NEA
Class III->	Profile: Europe EAC
Class IV->	Barrier: Y, Construction: Y
Class V->	Rate: NEA DIV
	Posture: Protracted Period; Intensity: Reserve
Class VI->	Use [Y/N]: N, Climate:
Class VIII->	Echelon: ECH 1 & 2 (DIV), Theater: MRC-W
Water->	Echelon: Division, Climate: Temperate

Combat mission parameter sets. (Note the change in parameter set ->)

Phase: 1 Phase Length: 1.00 Days
Task Organization: Engineer
Parameter Set: Attack; Succeeding Days; Moderate
Rate: NEA DIV

Posture: Attack; Succeeding Days
Intensity: Moderate; Strength: 100 percent
Unit: 05335L000 Engr Bn, Hvy Div
Qty: 1, Str: 444

LIN	QTY	Weapon Nomenclature	DODIC	DODIC Nomenclature	CBT Load	Rounds	Weight	Cube
C18234	28	Carrier Personnel Full TR	A576	CTG CAL .50 M8	50,400	1,786	696.60	8.93
1049	6	Carrier Cargo: Tracked 6	A576	CTG CAL .50 M8	5,400	383	149.27	1.91
D11538	4	Carrier Command Post: LIG	A576	CTG CAL .50 M8	3,600	255	99.51	1.28
D30897	6	Dispenser Mine: M139 (HTL)	K045	Mine, XM87, Volcano	960	1,018	44,797.72	2,514.78
E56578	6	CEV FT 165 mm Cannon M728	A131	7.62 mm 4 Ball, 1 TRA	21,600	1,112	111.21	2.22

Table 1. OPLOG Planner estimated ammunition consumption report for an engineer battalion, heavy division

Unit Total for Engr Bn, Hvy Div	DODIC	DODIC Nomenclature	Rounds	Weight (lb)	Cube
Weight (lbs): 52,560.34					
Short tons: 26.28	A059	5.56 mm Ball M855 10	9,797	489.83	9.80
Pounds/Man-day: 118.38	A063	5.56 mm Tracer M856	3,740	149.40	3.74
	A064	5.56 mm Ball-1TRL	0	0	0

Table 2. Total ammunition consumption for an engineer battalion in the attack (OPLOG Planner).

Solution

These problems can be corrected by using OPLOG Planner ammunition factors with a spreadsheet program, such as Microsoft Excel, to forecast ammunition requirements. After downloading OPLOG Planner text files to a disk, the files can be reopened in the spreadsheet program. The user can "manually" separate the amount of ammunition forecasted for an engineer battalion and express it as an engineer company forecast in the spreadsheet format. The user can then input DODICs into the spreadsheet that are not accounted for by OPLOG Planner. Engineer planners can use OPLOG Planner consumption rates from the spreadsheet to determine ammunition forecasts for MICLICs and MK19s. For example, OPLOG Planner determines Volcano consumption in terms of individual mines. Volcano reloads can be accurately forecasted by dividing the OPLOG Planner consumption rate by a factor of 6, which is the number of canisters in each Volcano DODIC.

Engineer Forecasting

Forecasting ammunition requirements for combat operations is an integral part of the engineer planning process and should be included in the Engineer Estimate. After receiving a mission, engineer planners know the type of operation the unit will perform. During the battlefield assessment and intelligence preparation of the battlefield, engineer planners determine the enemy's capabilities. These analyses indicate the types of targets to expect and the battlefield conditions. From this information, the planner develops a tentative list of ammunition the unit will need for a mission. In analyzing engineer missions, planners further determine which parameters impact the mission (figure, page 29).

While developing the scheme of engineer operations (SOEO), planners determine which engineer assets to use in the mission. FM 5-71-2, pages 3-10 and 3-11, states that "There are some specific considerations that the engineer staff officer should consider as he develops his SOEO." These include task force breaching capabilities and adequate fire-control measures to support breaching. Engineer planners should coordinate with the fire-support officer for artillery fire as related to the task force mission. If the mission requires scatterable mines, engineer planners forecast the ammunition needed to achieve the desired obstacle effect. Field artillery munitions that are important to engineers include the area denial artillery munition (long duration) (DODIC D501), the area denial artillery munition (short duration) (DODIC D502) and the remote antiarmor mine-(long duration) (DODIC D503).

After developing the SOEO, engineer planners determine the types and quantities of ammunition the unit needs to accomplish the mission. They use OPLOG Planner and a spreadsheet program during the wargaming and refining phase of the Engineer Estimate. After engineer planners run OPLOG Planner for each possible course of action (COA) and analyze the results, they forecast ammunition requirements for each COA. The forecasted requirements are used as criteria to determine which COA to recommend to the commander. After he decides on a COA, the OPLOG Planner results for that COA are used as the engineer ammunition forecast for the mission. Give a copy of the results to the task force S4 and the support platoon leader to ensure that the engineer-specific ammunition forecast is included in the task force logistics plan.

Tools

Forecasting engineer ammunition requirements for combat missions is an important job for planners who work in a task force environment, where engineer companies may use a variety of Class V items depending on the mission. It is the task force engineer officer's responsibility to forecast, determine, and source engineer ammunition requirements. By understanding the basic ammunition terms and definitions, engineer planners can formulate a plan to accurately forecast Class V requirements. The Engineer Estimate will alleviate some forecasting uncertainties. Using OPLOG Planner to forecast initial ammunition requirements and a spreadsheet program for additional requirements lead to an accurate engineer ammunition forecast. This forecasting process provides engineer planners the fundamental tools to forecast the proper type and amount of ammunition needed to complete their assigned combat missions.

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PERSCOM Notes

By Sergeant Major Jay Florance

When the command sergeant major/sergeant major list was released in December 1998, many noncommissioned officers (NCOs) had their day brightened, as they became the new senior enlisted leadership for our Army. They deserve our congratulations. Army promotion boards always try to promote the best NCOs, and they usually do. But we know that some excellent soldiers are not promoted simply because their Noncommissioned Officer Evaluation Reports (NCOERs) are weak or unclear. During my two years of duty at PERSCOM, I have reviewed the records of every engineer NCO. I am taking this opportunity to pass along my thoughts about what results in promotion selection.

On the whole, most NCOERs don't paint a picture that helps the promotion board select the best candidates. There usually are three or four NCOs who have had stellar careers or unique events that clearly place them in the upper percentile of their grade and military occupational specialty. Such events include being selected Drill Sergeant of the Year or Soldier of the Year. But only a few soldiers achieve those high standards, and there is a huge bubble of soldiers grouped in the middle who compete for promotion.

The NCOER is the key to who gets promoted, but many of them don't say anything substantial. The words may be there, but they lack significance. Phrases such as "Leads from the front," "Places unit goals above his own," or "Consistently demonstrates sound judgment" do not relate to promotion. Nor do they say anything significant about the soldier's performance over the past 9 to 12 months. If promotion board members read those or similar comments on 50 NCOs and only 30 NCOs can get promoted, which 30 should they select? The following recommendations will help rating officials prepare strong NCOERs that send the intended message.

Raters: Part IIId, *Area of Special Emphasis*, should relate to *the* event that occurs during the rating period. It may be a rotation at the National Training Center or the Joint Readiness Training Center, a deployment, or a field training exercise, etc. Since this is the most important event of the rating period, gear the first comment in each rated area on the back of the NCOER to it. If a rater includes *the* event on the front of the NCOER but does not add comments about it on the back, the reader may assume that the soldier's performance was less than successful. Excellence and success, or lack of success, should be clearly identifiable based on this key event. Describe day-to-day events or performance in the second and following bullets.

Raters should also consider other factors. When listing three positions for future duty, don't forget about observer/controller (OC) duty at a combat training center. We need to know which NCOs to place in these key positions and don't want to guess! Recommend only your best NCO for an OC position. Also, staff sergeants should rate other staff sergeants only when absolutely necessary! They normally do not provide a strong description of duty performance and generally rate the soldier lower than a more experienced NCO would. Finally, understand that if you rate a soldier "fully capable" rather than "among the best," that soldier probably will not get promoted. If your NCO is not the best, why isn't he? Have you counseled the NCO on what is needed to become the best? Do you have a best?

Senior Raters. Weigh in with your comments! Whether you realize it or not, senior raters really drive the train. Platoon leaders: Who is your best squad leader? Company commanders: Who is your best platoon sergeant? Battalion commanders: Take a bow—you do a great job stating who your best first sergeant is. Prepare a bullet for each area, performance and potential. Too many NCOERs have conflicting messages. For example, if the comment "Ready to perform duties as first sergeant" is paired with a potential rating of "2," the NCO will not be selected. That combination raises the question of how an NCO can be ready without a potential of "1." When company commanders do not indicate who their best platoon sergeant is, that soldier probably will not get promoted. Don't shortchange your best NCO! If you don't identify your best NCO, his chance for promotion is about one in 50.

This is my last PERSCOM Note, since I am preparing to move to Germany. It has been an honor to be the Engineer Branch sergeant major for the past two years. Sergeant Major Fillmore will arrive in May, and I'm sure she will continue to take care of the Engineer Corps.

Sergeant Major Florance serves as the Engineer Branch sergeant major at PERSCOM. His e-mail address is florancj@hoffman.army.mil.

Civil Disturbance Operations for Mechanized Engineer Battalions

By Captain Mark A. Geraldi

With the proliferation of operations other than war (OOTW), civil disturbance missions are no longer owned solely by light infantry battalions. Correctly employed, mechanized combat engineers can be major players in future OOTW deployments. For example, units currently deployed to Bosnia have faced and probably will continue to face civil disturbance scenarios in that theater.

The 1st Cavalry Division's 8th Engineer Battalion at Fort Hood, Texas, demonstrated the effectiveness of a mechanized engineer battalion in such a role when it deployed to Panama for Operation Safe Haven/Safe Passage during 1994 and 1995. As a line platoon leader, I was an active participant in this innovative role for combat engineers. This article details the task organization and deployment, the specialized equipment, and the training and tactics that a mechanized engineer battalion must employ to conduct effective civil disturbance operations.

Task Organization and Deployment

The United States constructed four camps in Panama to house Cuban refugees while they awaited entry into the United States. On 7 and 8 December, 1,000 of more than 8,000 refugees escaped during an extremely violent riot. More than 200 U.S. military personnel were injured, with 18 of them hospitalized. The 8th Engineer Battalion's role was to reinforce the severely outnumbered and underequipped joint task force soldiers, marines, and airmen guarding the camps.

The battalion began its notification sequence at 1600 hours on 11 December 1994. My company held its first muster formation for this "Drawn Saber" alert (a muster in field uniform with the remainder of the gear packed in duffel bags) two hours later, which is the division standard. The company had participated in a brigade-level sea deployment readiness exercise six months earlier, so the squad leaders had

Sappers from the 2nd Platoon, Alpha Company, 8th Engineer Battalion, conduct tent-clearing operations as part of their civil disturbance training during Operation Safe Haven/Safe Passage. The soldiers are in a modified uniform (no blouse) for this training due to the extremely hot and humid weather.

little difficulty in directing the initial steps of the deployment preparation while the commander briefed senior leaders.

To support Operation Safe Haven/ Safe Passage, we modified our basic task organization. The two line platoons in each company were the focus of the battalion's effort. Soldiers from the assault and obstacle platoon augmented the line platoons to bring them up to their full 29-man strength. Each line platoon also deployed all four of its M113 armored personnel carriers (APCs), a HMMWV, and all other modified table of organization equipment. The commander attached the remaining soldiers from the assault and obstacle platoon to the company headquarters section to form a small transportation section. The assault and obstacle platoon leader served as liaison to the local U.S. infantry battalion (5-87th Infantry) after we arrived. The headquarters section deployed the remaining three HMMWVs, a 5-ton cargo truck, and a HEMMT (a heavy, expanded-mobility tactical truck). The combat engineer vehicles (CEVs), armored vehicle-launched bridges (AVLBs), and armored combat earthmovers (ACEs) remained at the home station.

The company loaded its vehicles and equipment onto C-5 Galaxies and C-141 Starlifters and left Fort Hood by 2200 on 12 December. The main body of the battalion, with full field gear and personal sensitive items, departed later that evening. This was the largest airlift of mechanized forces since Operation Desert Shield.

We arrived at Howard Air Force Base, Panama, on the morning of 13 December. The joint task force headquarters, known as Joint Task Force Safe Haven, informed us that the riots had ceased and all but 10 of the escapees had been apprehended. Initially we were to serve as a mechanized quick-reaction force that could project from our jungle base camp to quell any new flare-ups by the Cuban refugees.

Based on the clarified mission and situation, the commander directed both line platoon leaders to conduct a reconnaissance of the four refugee camps and the one confinement facility known as "Camp 5." Our recons focused on the standard military aspects of terrain—OCOKA (observation and fire, cover and concealment, obstacles, key terrain, and avenues of approach). We noted such things as fields of fire (the rioters inflicted most of the injuries by throwing jagged stones found along this part of the canal), areas in which our troops could take cover from such projectiles, and concealed areas that refugees could pass through or ambush from. We also recorded locations of natural obstacles and potential man-made barriers that rioters could hastily erect, key terrain such as choke points (one camp entrance was through a constricted canyon), and avenues of approach for dismounted troops and APCs. Since we were the only mechanized unit in Panama, we conducted several bridge classifications and constructed an improvised bridge over aboveground plumbing for one camp.

Specialized Equipment and Modifications

Civil disturbance operations required us to either modify existing equipment or acquire new equipment. At Howard Air Force Base, our supply sergeant issued each soldier a complete set of riot gear that included shin guards (the same type that baseball catchers use), a Plexiglas shield, a Plexiglas face visor that attached to the kevlar, and a 3-foot wood baton. The main purpose of this gear was to protect against projectiles such as rocks or tent poles that the rioters sharpened and used as spears. We donned the gear when we moved large numbers of refugees from one camp to another or were alerted.

We also wore a stripped-down pistol belt with a 2-quart canteen on our backs and had protective masks that hung on our front sides over the groin. The position of the masks served two purposes: protection and accessibility in case we employed riot-control agents. Soldiers wore flak jackets and leather gloves for additional protection. We reinforced our shields with 100-mile-an-hour tape along the edges and placed two strips in an "X" pattern across the front. The entire ensemble was hot but offered excellent protection.

We removed the lanyards on the batons because our soldiers were not experts in their use and risked being pulled into a rioting crowd if the lanyard was attached to their wrist and refugees grabbed the baton. We also carried four flexicuffs on the elastic snap loops of our flak jacket shoulder pads. The cuffs were prethreaded so we could quickly take them off to restrain a rioter. The ammunition pouch on our pistol belt held additional flexicuffs. Each of the two grenade pouches of the ammunition pouch contained a pepper spray bottle (with a 10-foot range). Soldiers at team leader level and above, track commanders, and drivers also had night vision goggles, which usually were stored in the squad APC.

Since we did not know how volatile the situation was, soldiers deployed with an M16 and bayonet, but we left the M249 squad automatic weapons behind. As soon as a forward base camp was established along the Panama Canal, we permanently stored our rifles in the field arms room. Once in country, we drew one riot shotgun per squad. We used birdshot in these weapons, which could be fatal at close range (10 meters or less) but not at longer distances. Platoon leaders carried 9-millimeter pistols. Local military police conducted ranges for both pistols and shotguns to improve our proficiency on these weapons. They remained in the arms room except when we deployed to a camp.

Other platoon equipment included mine detectors, which were used when searching the camps for buried caches of homemade weapons. Each platoon also brought five single-channel, ground-to-air radio systems (SINCGARS), which were taken from home station ACEs and CEVs. We configured them as manpacks so each leader

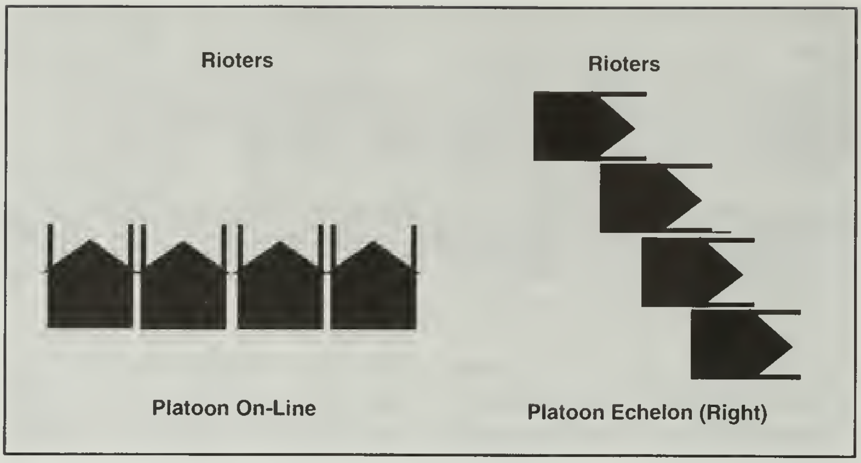

Figure 1. Dismount formations

in the platoon could maintain communications with the tracked vehicles while dismounted.

We also modified the APCs to better support the mission. Since it was a riot-control mission, we did not deploy our M2 machine guns from Fort Hood. We removed all external attachments from the APCs—such as pioneer boxes, tow cables, and oil cans—so rioters could not swarm the vehicle and use them as weapons. We also taped over the external handle of the onboard fire extinguisher. Some of the refugees had prior military service and could try to disable an APC. (During the initial riot, a rioter turned off the ignition of a passing HMMWV.) Drivers kept both the engine compartment and fuel cap combat locked at all times. We also mounted two rolls of concertina around the exhaust stack of each APC and stored pickets inside the vehicle. We used this barrier material for hasty roadblocks. Inside each tracked vehicle we stockpiled two cases of MREs (meals, ready-to-eat) and a 5-gallon water cooler.

Training and Tactics

Upon arriving in Panama, we initiated individual and squad-level training for such areas as squad formations and use of the baton and shield. A military police lieutenant deployed with our battalion to serve as a subject matter expert in civil disturbance operations. After a few days, the battalion and company adopted a more formal civil disturbance operations mission essential task list (METL), which focused our training. It followed the natural progression from individual and squad tasks to platoon and company formations and included rules-of-engagement training at all levels.

We practiced quick-reaction force alerts several times a day. The company standard was to roll out of camp fully geared within 20 minutes of notification. To accomplish this, each squad laid their gear on sheets of plywood outside their tents, and we parked the APCs next to the bivouac area.

Joint Task Force Safe Haven constructed two mock-up camps for training, and we conducted an exercise at one site using other joint task force soldiers as opposing forces. This beneficial exercise exposed us to some of the frustrations typical of civil disturbance operations, especially the incessant jeering of rioters and continuous barrage of projectiles.

We developed a series of tactics to use when dismounting troops near rock-throwing rioters. These formations allowed us to dismount and assemble into riot-control formations out of direct fire (Figure 1). Drivers drove buttoned up so they were fully protected from threats such as gasoline fire bombs.

Another mission was to serve as a mobile roadblock if the refugees broke out. The tactic we developed involved tying into the impenetrable vegetation that grew on either side of every road. Two squads pulled into a predesignated site and strung triple-standard concertina across the road. Dismounted troops stood behind the wire to prevent escapees from creating a breach, and we positioned APCs behind the soldiers as a final backstop.

The APCs were positioned in a Vee formation to create a gate effect on the road (Figure 2, page 35). If the wire did not hold the rioters, the soldiers could retrograde through the gap between the tracks, and the APC would reseal the hole. This allowed soldiers to make a second stand from the top or behind the vehicles or remount the APCs and button up if the crowd was too large. We also developed an obstacle plan for key avenues of approach. At critical choke points, we erected tanglefoot on the shoulders of the road and 11-row wire obstacles. For the 11-row obstacles, we secured concertina on only one side and kept it coiled so the road remained open but could be rapidly sealed off. The only difficulty with the obstacles in remote areas was that they soon fell prey to scavengers.

To relieve monotony after several weeks of continuous civil disturbance operations training, we conducted jungle survival training and dismounted patrolling with the 5-87th Infantry Battalion "Light Fighters." We also ran an M16 range and a 50-foot rappelling tower for the company. These training events were critical in maintaining and improving esprit de corps.

Unit Success

Throughout the three-month deployment to Panama, our company had no Cuban refugees escape and no riots erupt. The deployment concluded with Operation Safe Passage, which entailed moving the refugees from our camps to Guantanamo Bay, Cuba. This phase of the deployment also was without incident.

The unit's successes were largely due to the adaptation of our mechanized engineer battalion to conduct effective

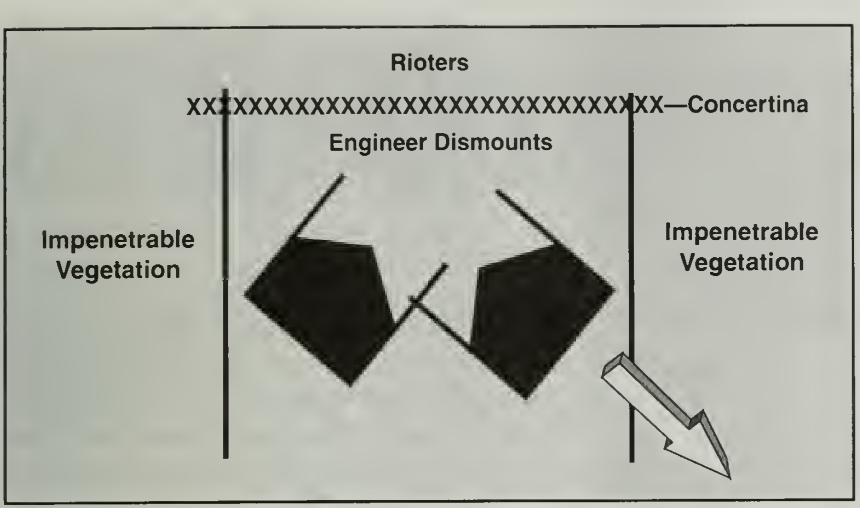

Figure 2. Hasty roadblock

civil disturbance operations. For example, the focus on the line platoons was critical in building a highly mobile, quick-reaction force. The APCs offered a level of protection that light forces do not have and permitted us to dismount close to rioters without facing a hail of stones. The protective equipment and array of weapons provided the flexibility to respond to varying levels of violence by rioters. The tiered training plan and realistic training events rapidly built up the soldiers' ability and confidence in this otherwise foreign mission. Finally, occasional adventure training provided the variety necessary to maintain the soldiers' morale during this extended deployment.

Honing in on these basics is an effective way for a mechanized engineer battalion to adapt to civil disturbance operations. Correctly employed, combat engineers can be major players in future OOTW deployments in any environment, whether it is the jungles of Panama or the rugged terrain of Bosnia.

Captain Geraldi is the 1st Brigade engineer, 101st Airborne Division (Air Assault), 326th Engineer Battalion, Fort Campbell, Kentucky. He previously served as a platoon leader and a company XO, 8th Engineer Battalion, 1st Cavalry Division, Fort Hood, Texas. CPT Geraldi holds a master's degree in engineering management from the University of Missouri-Rolla.

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(Continued from page 11)

may have difficulty recognizing the M113 as friendly. This dilemma is evidenced by the consistently high losses of engineers to enemy contact at the combat training centers, the fratricide of engineers from the 82nd Engineer Battalion during Operation Desert Storm, and the recent training death of M113-mounted engineers at the National Training Center. The vulnerability of the M113 to most weapons on the battlefield, its lack of firepower, the difficulty friendly forces have in recognizing the M113 as friendly, and the fact that our mission places engineers forward of friendly defensive positions and in the gauntlet of fires during breaching operations create a deadly combination. It leaves engineers with a recipe for mission failure and fratricide.

Engineers mounted in BFVs offer the BCT increased versatility. When mounted in M113s, engineers command and control mobility and countermobility assets but must rely on maneuver forces for protection. This requirement often drains the already-stretched firepower of infantry and armored forces. As the structure of the division is reduced, this burden will increase. Engineers in BFVs can protect themselves during movement and can provide their own protection during obstacle reduction. In the defense, engineers in BFVs can relieve infantry and armored forces from the need to escort the Volcano because they will have the firepower needed to accomplish the mission.

The transition from the M113 to the Bradley fighting vehicle will dramatically improve the survivability, lethality, and versatility of combat engineers during the close fight. It also will create the commonality required to effectively streamline the CSS system and provide a platform to launch combat engineers into the future. Clearly, combat engineers must rapidly transition to the Bradley fighting vehicle to support overall mission accomplishment now and well into the 21st century.

ROBOTS CLEAN UP THE COLD WAR MESS

By Mark D. Kessinger

Fearful that Hitler's Germany might invent the world's first atomic bomb, the United States began the Manhattan Project in 1942 to secretly build the bomb before the Germans. In less than three years, we successfully built both uranium and plutonium bombs. During that time, the U.S. Army Corps of Engineers managed the construction of monumental plants to enrich uranium, production reactors to make plutonium, and reprocessing plants to extract plutonium from the reactor fuel. On 6 August 1945, the United States dropped a uranium bomb (called Little Boy) on Hiroshima, Japan, and on 9 August we dropped a plutonium bomb (called Fat Man) on Nagasaki. Japan surrendered 23 days later.

Following World War II, relations between the United States and Russia were strained, and with an impending threat from the Soviets, the Cold War began. Over the next five decades, the United States spent an estimated $300 billion manufacturing nuclear weapons. This ended in 1991, when the sudden collapse of the Soviet Union brought an abrupt end to the nuclear arms race and the Cold War.

Now, the Corps of Engineers is assisting the Department of Energy (DOE) in decontaminating and decommissioning portions of the nation's vast nuclear weapons sites with the help of robots.

The Cold War Legacy

Like most industrial and manufacturing operations, the production of nuclear weapons has generated wastes. But unlike other wastes, these have unique radiation hazards. In the late 1980s, all major facilities in the nation's nuclear weapons complex were shut down temporarily. Because the end of the Cold War was so sudden, many facilities were not closed properly. Much of their wastes remain in temporary storage and pose environmental and health risks. The DOE currently owns and maintains more than 2,000 contaminated buildings that will require decontamination and decommissioning. It also must remediate about 2,700 metric tons of spent fuel, 100 million gallons of high-level waste (enough to fill 10,000 tanker trucks), 100 metric tons of plutonium, and 550,000 metric tons of contaminated metal.

In its 1995 Baseline Environmental Management Report, the DOE estimated that it would take 75 years and $227 billion to clean up the nuclear weapons complex. Because of this enormous price tag, in June 1997 the DOE introduced its "2006 Plan." Formerly called the "Ten Year Plan," it urges the use of innovative technologies, processes, and thinking to clean up many of the sites by the year 2006 at a cost of about $120 billion.

Interagency Agreement

The DOE's Federal Energy Technology Center (FETC), located in Morgantown, West Virginia, and Pittsburgh, Pennsylvania, has the lead for developing innovative technology to decontaminate and decommission the nation's nuclear weapons complex. In 1995, the FETC executed an interagency agreement with the Army that allows the Corps of Engineers to assist the DOE in a variety of areas, including cleanup of the nuclear weapons complex. The Corps Huntington, West Virginia, district serves as the Army's program director for the agreement. It assigns work to the Corps district that is nearest to the DOE project, if that district has the necessary expertise and resources.

Projects

The Corps played a major role in building the nuclear weapons complex in the 1940s, and now it is a vital part of the team that is decontaminating and decommissioning these facilities. Currently, the Corps is helping the FETC decontaminate and decommission a portion of three sites: the Chicago Pile 5 Reactor at the Argonne National Laboratory; Fernald's Plant 1 near Cincinnati; and Hanford Reservation's C-Reactor near Richland, Washington.

Chicago Pile 5 Reactor. This heavy-water, uranium-fueled, thermal reactor operated for 25 years before shutting down in 1979. Decontaminating and decommissioning the reactor includes removing the reactor core and the biological shield structure, decontaminating the rod storage area, and dismantling the structure.

Fernald. At this plant, uranium ore was milled for distribution to other nuclear weapons sites. The work generated low-level radioactive dust, which settled over much of the 1,000-acre site.

C-Reactor. This full-scale surplus production reactor was constructed rapidly in 1951 to respond to increased tensions in the Cold War. The reactor started up in November 1952 and operated until April 1969. The C-Reactor was scheduled to be the first of eight reactors at Hanford to be dismantled.

However, due to site priorities and limited resources, the DOE is exercising the option to maintain the reactor in safe storage for 75 to 100 years before final disposition.

New Projects. Four new cleanup projects are getting underway: at Mound, Ohio; the Los Alamos National Laboratory in New Mexico; the Savannah River National Laboratory in South Carolina; and the Idaho National Laboratory.

Technology

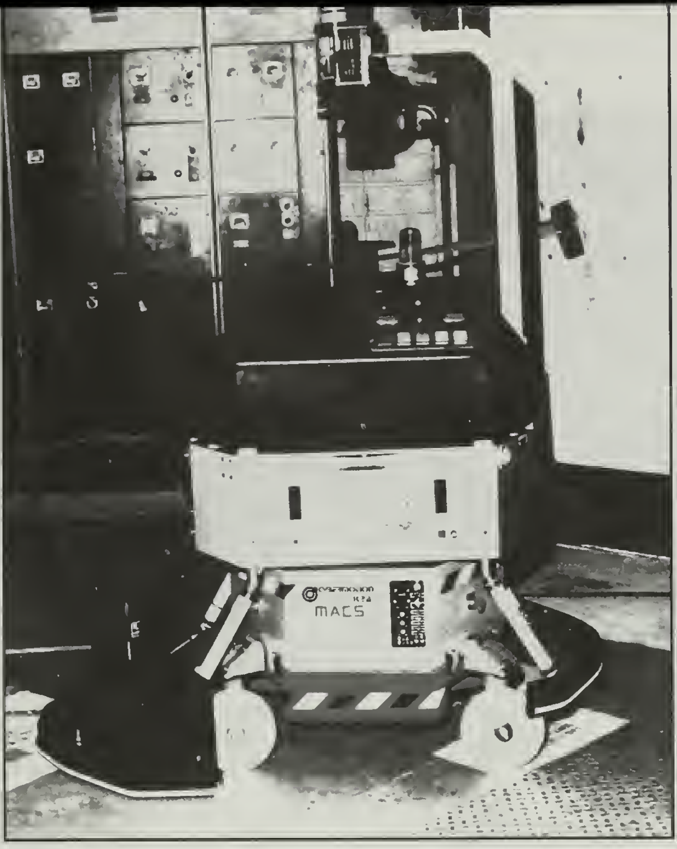
FETC's ultimate goal is to demonstrate innovative technologies and processes and facilitate their acceptance and deployment for repetitive and reliable uses across the nuclear weapons complex. The Corps provides management support and cost engineering services to determine the performance and cost effectiveness of these technologies and processes.

Robots are an example of innovative technology that is used successfully to clean up nuclear weapons sites. This equipment includes the following:

Mobile Automated Characterization System (MACS). The MACS is a battery-powered, autonomous robot with a laser positioning system. It can detect alpha and beta contamination on floors and perform long-term surveillance and maintenance tasks. Because it is operated from a remote location, the MACS reduces worker exposure and provides accurate characterization data. (See top photo.)

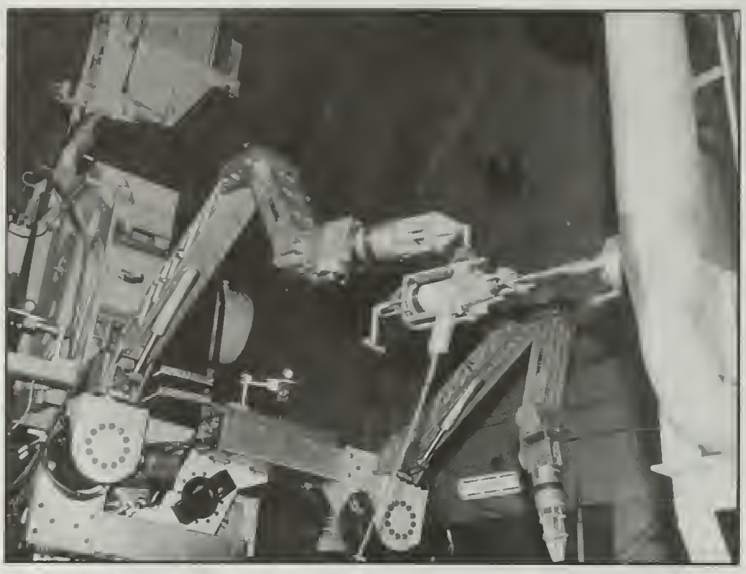
Rosie Remote Work System. A remote mobile work system called *Rosie* provides a telerobotic, mobile platform from which other robotic tools can be deployed for a variety of demolition and decon-tamination tasks. At the Chicago Pile 5 Reactor Project, Rosie broke up high-density concrete in an hour. In comparison, it would take several days for workers using jackhammers to complete this task. (See bottom photo.)

Dual-Arm Work Platform (DAWP). The DAWP has two hydraulic manipulator arms that are mounted on a hydraulic positioning base. Equipped with a circular saw, it cut up large sections of the Chicago Pile 5 Reactor, removed contaminated lead



The Mobile Automated Characterization System can detect alpha and beta contamination on floors.

"Rosie" performs manual dismantlement, waste handling, and packaging using standard handheld tools.



The Dual-Arm Work Platform can be mounted on deployment devices such as Rosie-C, overhead cranes, telescoping booms, and remote vehicles.

panels, and dismantled graphite bricks. This equipment can accept a variety of tooling configurations, and its remote operation removes workers from high-radiation environments. (See photo above.)

Lessons Learned

The United States' unleashing of the fundamental power of the universe with the atomic bomb is one of the greatest accomplishments of our time. Although it was an enormous challenge to build the nuclear weapons complex, to safely and effectively decontaminate and dismantle these facilities may be an even greater challenge. This endeavor will require an enormous level of commitment and cooperation from governmental agencies, federal and state regulators, industry, academia, and the public. We must safely accomplish the enormous undertaking of cleaning up the aftermath of the Cold War. To do so, we must use ingenuity to develop and modify robots that can work effectively on delicate and heavy decontamination and dismantling tasks in highly radioactive environments.

For more information, contact Mark D. Kessinger, the Army's National Program Manager, at (304) 529-5083 or at *markk@mail.orh.usace.army.mil.*

Mr. Kessinger is the Corps of Engineers National Program Manager for support to the Department of Energy's Federal Energy Technology Center. Previous assignments include Corps liaison to the Department of Energy and engineering staff specialist with the Great Lakes and Ohio River Division in Cincinnati. Mr. Kessinger holds a master's degree in engineering management from West Virginia University.

Reference:

Closing the Circle on the Splitting of the Atom, U.S. Department of Energy, Office of Environmental Management, Second Printing, January 1996.

All photos courtesy Department of Energy.

(Continued from page 10)

task organizations are mission-specific, knowledge beyond generic capabilities is required. This knowledge is critical when forecasting the support available from each organization.

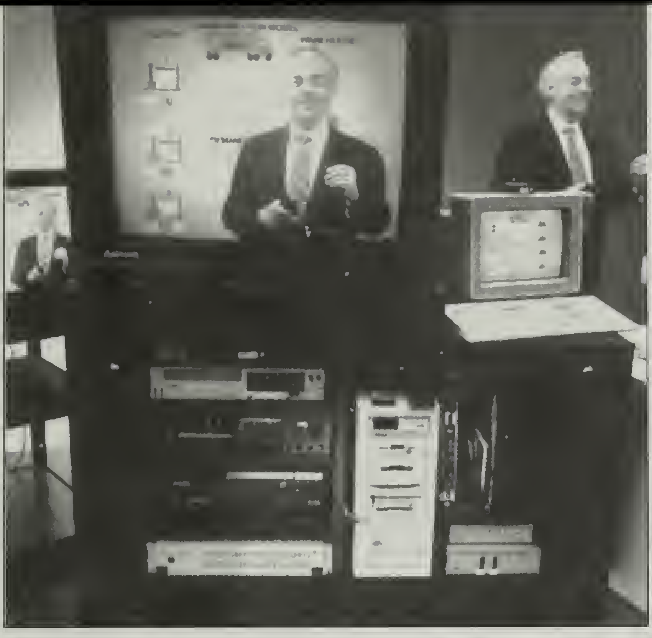
- **Encourage cooperation at the lowest level.** In peace support operations, people on the ground are closest to the problem, usually have the greatest insight, and often make the greatest contributions. They should not be hindered by unnecessary bureaucracy and should have the flexibility to create ad hoc relationships.
- **Carefully assess resources.** Specify "who will provide what" in an operation. Military engineers often have more manpower and equipment resources than discretionary funding, while CA teams have access to funding sources. To avoid half-finished projects that may be viewed negatively, assess all resources when developing a plan. Close coordination with logistics and transportation personnel is very important.
- **Link with the information campaign.** The success of both engineer and CA activities is magnified when woven into an information campaign. During peace support operations, the perception of the force—by the host nation, the international community, and at home—as a contributor to peace and stability is advanced by publicizing CA and engineer contributions.

A Final Word

As our Army becomes engaged in more and more peace support operations, we will continue to face unforeseen challenges and seek to solve complex issues that go beyond the realm of traditional military solutions. Engineer and civil affairs leaders must recognize that they have mutually supporting capabilities and look to forge a cooperative spirit. Through cooperation, these two organizations can magnify their separate contributions toward achieving the force's objectives.

Lieutenant Colonel Toomey, U.S. Army Corps of Engineers, commands the 14th Engineer Battalion (C), at Fort Lewis, Washington. He previously served as SFOR's Chief, Engineer Plans, in Sarajevo, Bosnia-Herzegovina. LTC Toomey is a graduate of the U.S. Military Academy.

Major Buckley is a reserve civil affairs officer and president of Bay Colony Engineering, based in Foxboro, Massachusetts. He recently served as a leading member of the Joint Civil Commission in Sarajevo, Bosnia-Herzegovina. MAJ Buckley is a graduate of the U.S. Military Academy.



Gaining Distance Education

By Captain Tim Wallace

Earning college credits is a challenge for most soldiers. Finishing a degree or just earning promotion points is a difficult goal for several reasons. Many soldiers do not have a flexible schedule that allows them to attend classes for a 16-week semester. Schools that are located near military posts and that cater to soldiers often have a limited number of academic programs. Constantly moving around the world makes it hard to earn enough credits from one institution to graduate, and transferring credits may be impossible because of different academic standards among colleges and universities.

Soldiers can overcome these challenges by enrolling in distance learning programs that let students earn credits without attending on-campus classes. Before taking my first multimedia-based distance education class from the University of Missouri-Rolla, I was skeptical of nontraditional education. I have since become a proponent of this new alternative to classroom learning.

Changes

Distance education has come a long way in the past few years. There are still advertisements on TV or the backs of magazines for correspondence schools that are not accredited or approved for tuition assistance and offer classes that lead only to a diploma or certificate. Now, however, many state universities and private colleges offer fully accredited associate's, bachelor's, and master's degrees with no on-campus attendance required. As the economy changes and education becomes more expensive, colleges and universities are changing their methods and policies to accommodate busy people who work and continue their education simultaneously. Even some of the most exclusive schools, such as Stanford University, Massachusetts Institute of Technology, and Duke University, recognize the importance of serving nontraditional students. Peterson's Education and Career Center lists hundreds of schools on its web site that offer associate degrees in 65 areas of study, bachelor's degrees in 73 areas, master's degrees in 74 areas, and doctorate degrees in three areas. There is a degree program to fit almost everyone's interests.

In addition to individual schools, several consortiums are forming around the country. The National University Degree Consortium consists of 13 accredited state universities that offer more than 1,000 courses, 16 bachelor's degrees, and 31 graduate degrees. In the summer of 1998, Western Governors University, a consortium of universities from 15 western states and Guam, opened its virtual doors to offer numerous degree programs to students "by focusing only on the skills and knowledge areas that they need." They call this "competency-based education." National Technological University, which offers advanced degrees to engineers, scientists, and technical managers, currently has 14 Master of Science degree programs taught by faculty from 48 leading engineering schools. National Technological University demonstrates its commitment to the busy working professional by offering its courses continuously rather than adhering to a semester or quarter calendar. For this convenience, students can expect to pay more than $600 per credit hour. This is expensive; however, the university is approved by the Veterans Administration for tuition assistance.

Communication Technologies

Off-campus students use a variety of communication technologies for course delivery, such as videotapes, videoconferencing, the Internet, teleconferencing, and correspondence. School administrators understand the benefits of student-teacher interaction and use a variety of means to maximize the time students have to interact with instructors and classmates.

Videotape

The most common delivery system for distance learning is videotape. Classes are videotaped during a normal on-campus class, and copies of the tape are sent to off-campus students. Many schools guarantee shipment the day after the class to ensure that distant students have adequate time to complete assignments. For most classes, completion requirements are identical to those for on-campus students.

Videoconference

Many schools set up remote sites so they can use videoconferencing for classes. The University of Kentucky and Old Dominion University in Norfolk, Virginia, offer classes by satellite to many off-campus locations throughout the country. These are the same classes that are taught at the main campuses, and students have the opportunity to ask questions and participate in class discussions just as on-campus students do. Off-campus locations are at community colleges, libraries, hospitals, military bases, and corporate sites. The University of Kentucky has 13 off-campus sites throughout the state and offers programs of study in seven undergraduate and graduate disciplines. Old Dominion University has 40 sites across the country and offers 11 degree programs.

Internet

The Internet is the fastest growing media used by schools to deliver classes. The Career and Education Editor of Peterson's says that 92 percent of colleges with distance education programs say they plan to use the Internet to a greater extent in their programs. City University in Bellevue, Washington, offers several electronic distance learning programs on the Internet using the university's online instructional center. City University currently offers more than 50 programs ranging from associate's to master's degrees in a wide variety of fields.

Nova Southeastern University in Fort Lauderdale, Florida, uses several communication technologies to deliver classes to their distance education students, but the Internet is the core to most of their classes and degree programs. In addition to communication among students in chat rooms and real-time electronic classroom online forums, students in advanced degree programs attend quarterly weekend conferences at the Fort Lauderdale campus. Nova Southeastern University's distance education offerings are almost exclusively for master's and doctorate degrees, and they have numerous programs in different areas of computer and information sciences.

Schools use varying levels of advertising to generate interest in their distance learning programs. Some advertise extensively, have a dedicated staff to assist students, and have detailed web sites packed with information. For other schools, distance education is not a priority, and the information that is available may be difficult to find.

The University of Phoenix has an informative web site geared toward assisting military members. Currently 40 percent of full-time students in its Center for Distance Education are military personnel. The university offers six undergraduate and five graduate degrees. Tuition is $365 per credit for undergraduate classes and $460 for graduate classes. Other schools with easy-to-follow web sites, such as Brigham Young University and the University of North Dakota, offer degrees but require students to attend one- to three-week seminars or labs during the summer. Brigham Young University offers a broad-based, flexible Bachelor of Independent Studies degree and charges $79 per credit hour. Walden University of Boca Raton, Florida, offers flexible master's and doctorate degree programs in management, education, and psychology geared toward working professionals and allows students to complete programs at their own pace.

Engineering Degrees

The University of North Dakota is the only school I have found that offers undergraduate engineering degrees that are fully accredited by the Accreditation Board of Engineering and Technology.

Of particular interest to Army engineer officers are programs that offer advanced engineering degrees. The University of Alabama's College of Continuing Studies offers graduate degrees in seven engineering disciplines, such as aerospace engineering and environmental engineering. During the spring term of 1999, the university will offer 41 graduate engineering courses. Another university with extensive graduate engineering programs is the University of Idaho, which offers 10 Master of Science and Master of Engineering degrees and more than 80 courses each semester. Both the University of Alabama and the University of Idaho offer thesis and nonthesis options to their graduate degrees and require no on-campus classes.

Auburn University offers master's degrees in eight engineering fields but requires students to pass on-campus oral examinations at the completion of their studies. Auburn also offers a program that culminates in a Master of Business Administration degree.

Getting Started

With all these opportunities available, it may be difficult to decide where and how to get more information. I started with commercial search engines like Yahoo and Alta Vista on the Internet. They offer so much information that its difficult to search through it. A more help-

Resources

University	Web Site
Stanford University	*http://www-scpd.stanford.edu/*
Massachusetts Institute of Technology	*http://web.mit.edu/sdm/www*
Duke University	*http://www.fuqua.duke.edu/programs/gemba*
Peterson's Education and Career Center	*http://www.petersons.com*
National University Degree Consortium	*http://sc.edu/deis/NUDC*
Western Governors University	*http://www.wgu.edu*
National Technological University	*http://www.ntu.edu*
University of Kentucky	*http://www.uky.edu/DistanceLearning/*
Old Dominion University	*http://www.odu.edu/~sbh/ttn*
University of Alabama's College of Continuing Studies	*http://bama.ua.edu/~disted/*
University of Idaho	*http://www.uidaho.edu/evo/*
Auburn University	*http://www.eng.auburn.edu/department/eop/*
International Association for Continuing Engineering Education	*http://www.dipoli.hut.fi/org/IACEE*
Nova Southeastern University	*http://www.nova.edu/cwis/disted*
Walden University	*http://wwwwaldenu.edu*

ul site is Peterson's Career and Education Center, which has nformation on available programs but does not have links to he various universities.

The International Association for Continuing Engineering ducation is a nonprofit organization with the objective of supporting and enhancing lifelong technical education and raining and advanced engineering education worldwide." It as dozens of links to universities and related sites in several ountries. The home pages of the consortiums mentioned bove offer links to their supporting universities and can usu-lly take you directly to the distance education department.

The most helpful and comprehensive site that I have ound is at *http://www.disted.com*. It contains an enormous mount of information from other nontraditional students, rofessional educators, and authors. Almost any topic in the istance education sphere is discussed on this site.

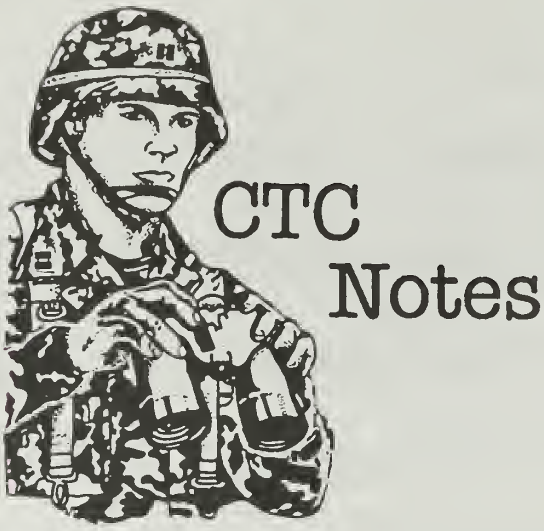
Several books offer suggestions and information. *Campus-ree College Degrees* by Marcie Kinser Thorson covers any programs in depth and only discusses legitimately ccredited programs. An overview of John Bear's book *ear's Guide to Earning College Degrees Nontraditionally* an be found at *http://www.degree.net*. The complete text of teve Levicoff's book *Name It and Frame It* is at *http://raining.loyola.edu/cdld/nifi.html*.

These Internet sites show the abundance of information available on distance learning. The difficult part is deciding which programs are most applicable to your situation. "The Consumers Guide to Choosing College Courses on the Internet" (*http://www.drake.edu/iaicu/consumer_guide.html*) can help make that decision. It also offers other links and postal addresses that may be useful.

Finding and enrolling in a distance education program may seem overwhelming. However, by using resources on the Worldwide Web and at military education centers, prospective students should find an option that fits their needs. Students may also find that distance education is not merely an acceptable alternative for traditional schooling, but the best means available anywhere to meet the needs of today's growing population of nontraditional students.

For more information, e-mail CPT Wallace at wallaceg@wood.army.mil.

Captain Wallace is a small-group instructor for the Engineer Officer Advanced Course, U.S. Army Engineer School. Previous assignments include Commander, B Company, 23rd Engineer Battalion, 1st Armored Division; plans officer, JTF-B DCSENG, Honduras; and platoon leader, executive officer, and battalion staff in the 27th Engineer Battalion, Fort Bragg, North Carolina.



Battle Command Training Program (BCTP)

Synchronizing the Plan: The Orders Crosswalk

By Lieutenant Colonel Ron Light

According to FM 101-5, *Staff Organization and Operations*, the chief of staff/executive officer (XO) bears the responsibility to ensure that war-fighting plans are integrated and synchronized. The XO also ensures that the staff "integrates and coordinates its activities *internally*, *vertically* (with higher headquarters and subordinate units), and *horizontally* (with adjacent units)."

The XO can significantly affect the synchronization of staff plans and orders during the conduct of the military decision-making process (MDMP). The *orders crosswalk* is a tool to do this. The methodology is simple, and the results usually are startling. Units that conduct their own orders crosswalks can dramatically improve battlefield synchronization of the engineer effort. In effect, the orders crosswalk is a tool to incorporate discipline in the MDMP.

While preparing an orders crosswalk is relatively straightforward, it requires time and an experienced eye. Whoever prepares the crosswalk must have both the experience to understand the "big picture" and the tenacity to ferret out the details of the scheme of engineer operations. Doctrine suggests that the person for this task is the XO. Others can be trained to perform the orders crosswalk, however, and it may be preferable if someone not involved with the orders preparation conducts the crosswalk. The important point is that the crosswalk is performed. Moreover, the earlier the orders crosswalk is performed the better. It is best to completes the crosswalk before the order is published.

During the orders crosswalk, look for two things. First, does your base order mirror the direction, guidance, restrictions, constraints, and tasks presented in your higher headquarters' base order, especially the commander's intent? Second, is your operations order synchronized throughout all battlefield oper-ating systems (BOS) areas and annexes? As you review the orders, list any disconnects you find.

The first step in conducting the crosswalk is to thoroughly read the higher headquarters' order. Starting with the base order, highlight or tab anything to do with engineers. Look for both implied and specified tasks. You must clearly understand what your higher headquarters will do and what it wants your unit to do. Next read your unit's base order. It should nest with the higher headquarters' intent and scheme of maneuver. After reviewing the two base orders for nesting and consistency, go to the annexes in your order.

The XO frequently directs a unit to "reduce the size of its order," but most orders remain fairly hefty. While a review of all annexes is not required, a thorough crosswalk requires that at least the following annexes in both the higher headquarters' order and your order be reviewed:

1. Start the review with Annex A, *Task Organization*. Note all engineer units and prepare a "mass balance" worksheet of them. This is merely an accounting of all engineer units. For example, if the 123 Engineer Battalion is listed in the task organization as "123 En BN (-)," locate the detached units. After you have located all allocated assets, move on. During this and all succeeding steps, correct disconnects as you go. If you wait to perform the orders crosswalk after the order is published, you will have to issue a fragmentary order to correct disconnects.

2. Annex B, *Intelligence*. Focus on terrain analysis and the effects of terrain. What your intelligence officer and the higher headquarters' intelligence officer say about terrain must complement each other, if not match. Next check to see what the enemy capabilities are, especially with respect to engineers. Again, the analyses should be similar. You can improve the likelihood of this if your S2 volunteers to work with the G2 staff in developing the division intelligence annex and borrows liberally from their work. As before, seek to resolve all disconnects. Note what you read in this annex and in the others that follow and compare that information with information in Annex F, *Engineer*, later.

3. Annex D, *Fire Support*. By now you should begin to see how well the staffs have synchronized the orders, both within your unit and with your higher headquarters. Key things to focus on are the allocation of ADAM/RAAM and, more importantly, authority for these and all other scatterable mine systems and special-purpose munitions. You should see some annotations regarding the use of GATOR mines and smoke.

4. Annex E, *Rules of Engagement.* This annex frequently is not synchronized with the subordinate unit's order. Key disconnects often include the authority and approval process for scatterable mines, the use of antipersonnel mines, the destruction of key roads and bridges, and restrictions on the use of obstacles. Crosswalk this annex with Appendix 4 (*Legal*) of Annex I, *Service Support.*

5. Annex F, *Engineer.* If you have reviewed the annexes listed above, you know how well the staff has synchronized engineer operations by the time you read Annex F. Key areas include the effects of terrain and weather, enemy engineer capabilities, scatterable mine authority and use (including all scatterable mines!), priority of support and effort (this should match with the base order), the controlled supply rate and required supply rate (CSR/RSR) of key munitions, the designation of obstacle zones and effects, and the use of host nation assets. The engineer overlay (Appendix 1) should have the same graphics as the operations overlay. Also, environmental considerations in Appendix 2 should be synchronized with Appendix 4 (*Legal*) of Annex I, *Service Support.*

6. Annex G, *Air Defense.* Review this annex for appropriate air defense support, especially during large-scale breaching or bridging operations. If air defense artillery (ADA) units are task organized to engineers in Annex A, make sure this information is in Annex G.

7. Annex I, *Service Support.* Apart from Annex E, this annex usually has the most synchronization problems. Cross check the CSR/RSR for critical munitions (for example, scatterable mines, MICLIC rockets, etc.). Note which main supply routes (MSRs) are "priority" MSRs. Engineers maintain them, but other units (ADA, military police, and combat service support) both support and complicate this maintenance effort, so a well-synchronized plan is essential. If Class IV/V (obstacle) supply points are established in Annex F, *Engineer*, make sure the locations match. Next, consider the engineer mission and assets needed to accomplish it. Is there a plan for Class IV/V (obstacle) distribution? Do engineers have any priority for maintenance? These and other questions will occur to you if the overall mission is clearly understood. Look for answers! For example, during a river-crossing operation, you would expect to see some priority of maintenance for bridge erection boats and assault float bridges. If you don't see any priority for that maintenance, now is the time to fix it—not after you cross the line of departure. Before leaving Annex I, crosswalk it with Annex N, *Rear Operations*, and look for disconnects regarding the priorities for MSRs.

8. Annex J, *Nuclear, Biological, and Chemical (NBC).* A quick review of this annex should indicate if the engineer and chemical staffs are talking. Look for integrated smoke plans (especially during breaching operations and river crossings), locations of decontamination sites (where engineers typically are tasked to dig sumps), and so on. We must take the lead in synchronizing our plans with the chemical staff as we establish the maneuver support concept.

Depending on the operation, you will check the remaining annexes by exception. In all cases, review them for tasks specified or implied for engineers. Although all tasks for units should be listed in the base order, you may be surprised at how many appear only in the annexes. Work with the appropriate staffs to list all tasks in one place—this is an important step to synchronize operations.

After completing the above review, analyze your notes. You probably found some minor disconnects, and you may have found some that could lead to fratricide, wasted effort, or a failed mission. Resolve all disconnects.

This completes the orders crosswalk process. It always takes effort...but it is always worth the effort.

Lieutenant Colonel Light is an observer/controller for the Battle Command Training Program at Fort Leavenworth, Kansas. He previously served as the S3 and XO of the 168th Engineer Battalion, 3rd Brigade, 2d Infantry Division, Fort Lewis, Washington.

NTC

NATIONAL TRAINING CENTER

National Training Center (NTC)

48-Hour Volcano Mines on the NTC Battlefield

By Lieutenant Colonel David Hansen and Major Fred Erst

Current Army doctrine does not provide the Brigade Combat Team (BCT) commander authority to execute scatterable munitions. This authority is retained at corps and division levels but may be delegated. Both levels usually delegate responsibility for conventional minefield emplacement to the BCT. When this aspect is combined with the world's current attitude against the use of conventional "dumb" mines (those without self-destructing capability), it is clear that the expanding use of special purpose "smart" munitions and scatterable mines with self-destructing or command-detonating capability will change the way engineers shape the battlefield.

Units training at NTC previously used 4-hour scatterable mines such as Volcano, MOPMs, and ADAM/RAAM with approval authority from the division and corps. The focus of that training was to develop tactics, techniques and procedures (TTPs) for employing 4-hour scatterable mines as situational obstacles. In 1998, NTC began training brigades to employ 48-hour Volcano minefields. Since then, brigades have begun to improve the integration of this lethal weapons system into the BCT military decision-making process (MDMP). Now it is essential that engineers drive the development of TTPs to expand the use of 48-hour Volcano and other scatterable assets at the brigade level.

Using 48-Hour Scatterable Mines to Support the Brigade Fight

Recent rotations have shown that brigades have difficulty employing 48-hour Volcano minefields as tactical obstacles on the NTC battlefield. Unfortunately, this problem is compounded by decreased productivity in the conventional obstacle effort. While Force XXI is driving changes in Army doctrine and organizations, war fighters must transition their countermobility efforts from reliance on conventional minefields to significant use of special purpose munitions and scatterable mines to shape the brigade fight. Engineers are expected to be dynamic and lethal. Their ability to plan, prepare, and execute 48-hour scatterable mines and special purpose munitions is essential in supporting the BCT. To effectively plan and execute those mines and munitions, engineer and maneuver units must train together to optimize their capabilities and minimize their limitations.

To better develop the use of 48-hour scatterable mines and special purpose munitions, engineers need to focus their efforts in the following areas:

- Command and control (C2) and emplacement authority.
- 48-hour Volcano minefield procedures.
- Scatterable minefield integration in brigade planning, preparation, and execution.

C2 and Emplacement Authority

FM 20-32, *Mine/Countermine Operations,* states that the corps commander has emplacement authority for all scatterable minefields within his area of operations. Current doctrine also states that for ground- and artillery-delivered scatterable mines with a self-destruct time of 48 hours or less, the corps commander may "…delegate emplacement authority to division level, who may further delegate to brigade level, who may then further delegate to task force level." There is a perception within the force, however, that the corps commander will retain rather than delegate emplacement authority for scatterable mines with a self-destruct time greater than 4 hours. As a result, while divisions may use 48-hour scatterable minefields during command post exercises and computer simulations, most brigades typically execute only 4-hour scatterable minefields during field training exercises at home station.

As engineers become more reliant on scatterable mine systems to achieve intended obstacle effects on the Force XXI battlefield, scatterable mine C2 and emplacement authority must change. While theater and corps commanders should maintain overall obstacle emplacement authority, division and brigade commanders need the flexibility and lethality that 48-hour scatterable mines provide. A recommended solution is to provide 48-hour scatterable mine C2 and employment authority to the division commander and provide 4-hour scatterable mine employment authority to the brigade commander, based on the theater and corps commanders' obstacle plans. These changes allow maneuver commanders to more rapidly use their scatterable mine capabilities and engineers to maximize their obstacle effort.

48-Hour Volcano Minefield Procedures

At NTC, the operations order (OPORD) for the 52nd Infantry Division (Mechanized) states that the division retains emplacement authority for all 4-hour scatterable mine systems and corps retains authority for all others. It also states that the BCT may request authorization to emplace 48-hour Volcano minefields by exception. The technique NTC uses to train brigades to synchronize the execution of 48-hour Volcano minefields with the corps and division fight is simple. In addition to obstacle-control graphics, the division OPORD also specifies a no-later-than (NLT) execution date-time-group (DTG) for the maneuver brigade to emplace all 48-hour scatterable minefields. This method ensures that the brigade's 48-hour scatterable minefields do not interfere with future corps and division operations. It also drives obstacle siting and integration as an issue for BCT and task force commanders early in defensive preparations.

During force-on-force operations at NTC, brigades are authorized one Volcano load (160 canisters) per ground or air Volcano system per mission. During the live-fire defense, the allocation is doubled to two loads per Volcano system up to a maximum of eight loads. This allocation provides the brigade the opportunity to employ several air and ground Volcano loads in the 48-hour mode. However, the brigade must comply with the following approval procedures and doctrinal requirements before executing any 48-hour Volcano minefield:

- Submit a request and receive approval for planning all scatterable minefields through the G3, 52nd ID, to the assistant division engineer (ADE).
- Emplace 48-hour Volcano minefields *before* the NLT execution DTG.
- Complete a four-sided fratricide fence before executing any 48-hour Volcano minefield that is emplaced behind the forward line of own troops (FLOT), according to FM 20-32. This typically is either a single-coil concertina or two-strand cattle fence. Units have the option to fence the obstacle group or fence each 48-hour Volcano minefield separately.
- After receiving approval to plan and complete the fratricide fence, the brigade may execute 48-hour Volcano minefields subject to final division notification and the scatterable mine warning (SCATMINWARN) procedure.

Scatterable Minefield Integration in Brigade Planning, Preparation, and Execution

During defensive operations, brigade personnel have difficulty synchronizing the execution of 48-hour Volcano inefields. This is because they do not adequately nderstand the amount of manpower, materiel, and time eeded to site and build the fratricide fence and emplace the 8-hour Volcano minefields *before* the NLT execution DTG. nadequate detailed reverse planning, ineffective time anagement, and the late arrival of Class IV/V materials eeded for fratricide fence construction usually cause most rigades to execute only a fraction of the 48-hour Volcano inefields possible. This shortfall often is compounded by he brigade's struggle to conduct task force Class IV/V point perations, Class IV/V haul, and manpower management, hich typically consume many hours of obstacle production ime. Late in the rotation, during the live-fire defense in ector, the BCT finally will commit enough additional anpower to emplace fratricide fences for the 48-hour olcano minefields. Ironically, on the few occasions when ngineer companies receive manpower augmentation from he task forces (usually infantry or tank loaders), the ugmentees do not come with the company/team small-unit eadership needed for effective supervision. Then the ngineer company leadership has the additional re- ponsibility to manage the attached manpower as well as rovide life support, security, and transportation. This added esponsibility often hampers 48-hour Volcano execution efore the NLT DTG, because the required amount of ratricide fencing is not constructed.

Planning and Preparation. Improvements to the DMP must begin at the brigade mission analysis briefing. he assistant brigade engineer (ABE) should identify otential targeted areas of interest as part of his terrain nalysis and discuss obstacle requirements versus shortfalls s part of the friendly capabilities portion of his engineer attlefield assessment brief. At the mission analysis brief, he ABE should provide the brigade commander a written Commander's Card” that describes friendly engineer apabilities and requirements. During the commander's uidance, the ABE must ask the brigade commander to iscuss his intent for employing scatterable mines and pecial purpose munitions. The brigade commander should iscuss intended obstacle effects on enemy maneuver, the llocation of scatterable mines/special purpose munitions to upport both the brigade's deep fight and the close fight, and he priority of emplacement of scatterable mines for 4-hour nd 48-hour duration.

To improve integration with the BCT scheme of aneuver, the ABE must ensure that planning for catterable mines is an integral part of developing the rigade's course of action. During the war-gaming step of he MDMP, targets for scatterable mines are integrated with irect and indirect fires throughout the depth and width of he battlefield for each enemy and friendly course of action. Engineer staffs can use a sketch to assist the commander in ffectively visualizing the scheme of obstacles and the ocation of observers, triggers, named areas of interest, argeted areas of interest, emplacement assets, and units covering the obstacle with direct or indirect fires. The ABE must develop and brief a detailed brigade countermobility time line that includes the brigade commander's critical information requests (CCIR), which serve to synchronize 48-hour Volcano execution.

Finally, engineers must improve task force ownership of brigade-directed 48-hour scatterable minefields by stating specified tasks for subordinate maneuver units in the main body of the brigade OPORD and in the Engineer Annex. Specified tasks include execution and overwatch responsibilities and manpower and Class IV/V requirements.

Execution. To improve scatterable mine execution, task forces may refine the brigade plan. They may submit requests for additional scatterable minefields through the brigade to the division. During engagement area development, obstacle integration for both conventional and scatterable minefields begins during obstacle siting. However, obstacle siting of 48-hour Volcano minefields by engineers, the maneuver company team, and the fire support officer *must* be the commander's priority due to their NLT execution times. The company team and engineer platoon must work together to position each scatterable minefield in the obstacle group using the direct fire plan and the initial obstacle group design. Based on the terrain, the company team commander and the engineer platoon leader should adjust obstacle locations to ensure that the obstacle group is covered by direct fires and the obstacle design is consistent with the task force commander's intent. The obstacle siting procedure described in FM 90-7, *Combined Arms Obstacle Integration,* serves as an effective guide.

Similarly, “ownership” of an obstacle group by the company team begins with obstacle siting and continues through obstacle turnover. While an obstacle group is emplaced by the engineer platoon, the actual “owner” is the company team overwatching the obstacles. The company team should provide security and manpower for fratricide fence construction and reload or mine-dump operations. This technique allows the engineer platoon to focus on its primary mission of emplacing minefields. It also allows the company team to account for, equip, transport, and supervise its personnel. It enables the company team to better prepare for obstacle turnover and lane closure during the battle and to recover fratricide fencing after the fight, when the scatterable mines self-destruct. Ownership ensures that the company team remains involved in obstacle construction and results in better integration of the direct and indirect fires needed to achieve the intended obstacle effect on enemy maneuver.

Specific actions for the successful integration of 48-hour Volcano minefields follow.

Commander provides guidance

- Allocate and prioritize resources for conventional and scatterable mines and special purpose munitions.
- Shape the brigade fight and the task-force fight.
- Determine employment requirements for 4-hour and 48-hour scatterable mines.

- Specify 48-hour scatterable minefields as brigade-directed obstacles or allocate them to an obstacle belt to achieve a specific effect.
- Discuss the effects that scatterable mines have on the brigade's repositioning and counterattack plans.

Brigade staff allocates and prioritizes resources

- Array maneuver companies and tenative obstacle groups against enemy battalion-sized mobility corridors.
- Establish priorities for countermobility efforts.
- Allocate resources for—
    - Firepower (direct and indirect).
    - Manpower (engineers and dismounts for fratricide fence).
    - Materiel (Class IV/V, scatterable mines/special purpose munitions, Volcano).
    - Time.

Brigade staff establishes ownership of obstacles in the OPORD

- Establish ownership of obstacles in the subunit instructions
- of the OPORD. Specify the brigade or task force responsible for obstacle emplacement and overwatch for obstacle belts, brigade-directed obstacles, and situational obstacles.
- Direct task forces to submit their obstacle plans so the brigade can prepare and disseminate a consolidated obstacle overlay.
- Direct task force manpower support for fratricide fence construction.
- Establish task force responsibilities for obstacle turnover, security, and lane closure.
- Specify task force responsibilities for obstacle recovery and battlefield restoration.

Brigade staff establishes and tracks CCIRs

- Submit the task force obstacle plan to the brigade NLT DTG. Include the obstacle group overlay, the obstacle execution matrix, and countermobility/survivability time lines.
- Track the status of Class IV/V materiel, the palletized load system (PLS) racks, material handling of equipment, haul assets, and manpower support.
- Establish 48-hour Volcano NLT emplacement times for—
    - Approval for planning, execution, and SCATMINWARNs.
    - Equipment and material on hand (Volcano, Volcano loads, and fratricide fencing).
    - Obstacle siting completion.
    - Fratricide fence completion.
    - Volcano minefield execution.

Future Requirements. The current Volcano system provides the engineer force only 4-hour, 48-hour, and 15-day self-destruct times. These self-destruct times often limit the engineers' ability to achieve the maneuver commander's intent. On the fluid battlefield of the 21st century, the need for intermediate self-destruct times would significantly enhance the effectiveness of scatterable mines in support of the BCT fight. Current battle rhythm and our improved ability to solidify operational plans at the brigade and task force levels support the creation of 12- and 24-hour self-destruct options. Scatterable mines and special-purpose munitions should be developed with 12-and 24-hour durations and an immediate self-destruct capability to provide that flexibility to the brigade. Engineer trainers at NTC also recommend that authorization for the employment of 12-hour scatterable mines and special purpose munitions reside with the BCT commander.

Conclusion

To successfully shape the Force XXI battlefield, engineers must drive the transition from conventional minefields to the employment of 48-hour scatterable minefields and special purpose munitions at the brigade level. When integrated with direct and indirect fires, scatterable mines and special purpose munitions provide the BCT the lethality and time needed to acquire and destroy enemy targets. As Force XXI engineer battalions are reduced in size, these mines and munitions provide the rapid emplacement capability needed to accelerate obstacle production. The self-destruction capabilities of scatterable mines and special purpose munitions reduce the long-term impacts of these minefields.

At NTC, the Sidewinder Team remains committed to maintaining conventional minefield skills and developing tactics, techniques, and procedures for planning, preparing, and executing scatterable mines. Through these efforts we will improve the brigade combat team's ability to conduct successful combat operations.

Lieutenant Colonel Hansen is the senior engineer trainer at the National Training Center, Fort Irwin, California. He previously served as commander of the 20th Engineer Battalion, 1st Cavalry Division, Fort Hood, Texas.

Major Erst is the assistant brigade engineer trainer at the National Training Center, Fort Irwin, California. He previously served as a company commander of the 10th Engineer Battalion, 3rd Infantry Division, Fort Stewart, Georgia.

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

ENFORCE XXI-99. The theme for this year's conference is "Joint Engineers: America's Total Engineer Force for the Next Millennium." Scheduled for the week of 26 April through 1 May, the conference will include numerous breakout sessions, tactical demonstrations, and dynamic displays. Registration information will be mailed in March. POC is CPT Elita Perusek, -7015.

Directorate of Combat Developments (DCD)

Tables of Organization and Equipment (TOE) Cyclic Review. The following TOE will undergo cyclic review for the Consolidation TOE Update (CTU). Request appropriate units review their TOE and submit comments regarding their concerns by the dates shown. Comments not in line with the mission of the review (minimum mission-essential wartime requirements) will not be considered.

TOE No.	October 1999 CTU Consolidated Unit
05413L000	Engineer Company, Construction Support
05423L000	Engineer Company, Combat Support Equipment
05424L000	Engineer Company, Dump Truck
05434L000	Engineer Company, Pipeline Construction
05473L000	Multirole Bridge Company

Comments due by 15 July 1999.

	April 2000 CTU
05500LA00	Headquarters and Headquarters Detachment, Engineer Battalion
05520LC00	Quarry Team
05520LD00	Headquarters Well-Drilling Team
05520LE00	Well-Drilling Team
05530LA00	Engineer Heavy Diving Team
05530LC00	Engineer Light Diving Team
05530LF00	Real Estate Team
05530LH00	Utilities (4000) Team
05540LA00	Topographic Planning/Control Team
05540LF00	Terrain Analysis Team (Heavy)
05540LI00	Command and Control Team (DS) (Heavy)
05540LN00	Terrain Analysis Team (Light Infantry Division)

Comments due by 15 December 1999.

To obtain a copy of a TOE undergoing review, send an e-mail request to Tom Knotts (knottst@wood.army.mil) or Garry Hamlet (hamletg@wood.army.mil). POC is Tom Knotts, -6139.

M917A1 Dump Truck. Fielding for the M917A1 dump truck began in April 1998 with Reserve Component units leading the way. The M917A1 is a nondevelopmental item for U.S. Army, Army Reserve, and National Guard units. The commercially designed 6x6 truck has a conventional cab, diesel engine, automatic transmission, two-speed transfer assembly, and antilock brakes. With a curb weight of 29,454 pounds (lb) and a gross vehicle weight rating (GVWR) of 68,000 lb, the truck operates on both JP-8 and standard Army diesel fuel. The M917A1 shares the same basic chassis as the type-classified M916A1 truck tractor. However, component upgrades to the transmission, transfer, and suspension systems accommodate production changes and an engine change to comply with current U.S. Environmental Protection Agency regulations. Added subsystems include a cab air-conditioner and central tire-inflation system. The heavy-duty steel body holds 14 cubic yards of material and has an 18.5-ton rating. Its double-action hoist system can be powered up and down from inside the cab. Other key features are—

- Air-transportable on C-17 and C-5 aircraft.
- 20-inch fording capability.
- 300-mile range at 40 mph at GVWR.
- Air-actuated tailgate.
- Material control system (on selected vehicles).
- Chemical-agent-resistant coating painted in a camouflage pattern.

POC is CW4 Bobby Russell, - 4074.

M917A1 Dump Truck

Engineer Personnel Proponency Office (EPPO)

Accession Board for MOS 215D, Terrain Analysis Technician. Eligible applicants are needed for an accession board scheduled to convene in July 1999 to access two vacancies. To date, no applicants meet the minimum requirements for this board. EPPO's home page was updated in December 1998 to reflect the need for eligible noncommissioned officers (NCOs) (grade E-5 or above) to apply for this MOS. Minimum requirements follow:

- General Technical (GT) score of 110 or higher.
- Sergeant (P) or higher.
- 81T MOS (previously 81Q).
- 4 years of experience in 81Q MOS.
- 1 year of experience at division level.
- 1 year of supervisory experience.
- Successfully completed the Basic Terrain/Topographic Analysis Course.
- Successfully completed the Advanced Terrain/Topographic Analysis Course.
- Current background investigation (within 5 years) required if appointed.

The Recruiting Command at Fort Knox has sent a letter to eligible 81T NCOs encouraging them to consider a career as a Terrain Analysis Technician. POC is CW4 Fred Tressler, -4088.

Lead the Way

By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School

One Corps, One Regiment, One Team

Over the last year and one-half, I have had the pleasure and the honor of serving as your proponent command sergeant major (CSM). During this time, CSM Ed Lugo, U.S. Army Corps of Engineers, and I have built a solid team with our organizations. CSM Lugo has been a valuable advisor and supporter, and together we have initiated many new programs and ideas. We have traveled together many times to visit units and meet with soldiers and noncommissioned officers (NCOs). We have demonstrated to our regiment that we are one team and have worked hard to improve the Engineer Regiment's relationship with Active and Reserve Component units and soldiers. CSM Lugo represents us well as an engineer soldier and Major Army Command (MACOM) command sergeant major. He is dedicated to making our regiment more effective and to improving the quality of life of our soldiers, civilians, and families. I appreciate our teamwork and look forward to a great year as we resolve the many challenges before us.

ENFORCE XXI - 99

The 1999 ENFORCE Conference is just around the corner—it is scheduled for 25 April-1 May. All of us at the U.S. Army Engineer Center and Fort Leonard Wood are working hard to make it the best ENFORCE Conference ever. The soldiers of the 1st Engineer Brigade are busy practicing and rehearsing their tattoo, which will be superb. Command sergeants major who come to the conference will be housed in the new Maneuver Support Center Noncommissioned Officers Academy billets. These billets are state-of-the art and very impressive. Packets for the conference will be mailed in March. For more information and the proposed CSM conference itinerary, visit the ECCSM's home page (http://www.wood.army.mil). Send us your key issues now, and we will present responses at the conference. Your feedback can help us improve the force structure, equipment, doctrine, and training that we provide for engineer soldiers.

Recruitment

The Army and the Engineer Regiment need your help. The effort to recruit soldiers for our Army is currently experiencing some rough times. The economy is doing very well, the United States has close to full employment, recruiting standards are at an all-time high, and many citizens perceive that America currently has no enemies—the reasons go on and on. U.S. Army recruiters are doing all they can to enlist high-quality, fully qualified soldiers into the Active and Reserve Components. Last year's delayed entry program account is almost zeroed out, and citizens who want to enlist and ship to training immediately are not signing up. As a result, Army training seats are not being filled and Army units are feeling personnel shortages. These shortages will continue to grow if we do not help. It is our responsibility, because it is our Army and our units that will be hurt. Here are some things you can do:

- Encourage high-quality young Americans you know to consider military service in a component of the U.S. Army. The benefits and cash and educational bonuses offered to enlistees have never been higher.
- Visit your local Army Recruiting Office. Offer encouragement and tell the recruiters how valuable they are. Offer your support and your unit's support.
- Call or visit your local U. S. Army Recruiting Company or Battalion Headquarters and offer your support and your unit's support.
- Support the local high school's Junior Reserve Officer Training Corps (JROTC) program. Visit them and help all you can.
- Encourage your best NCOs to serve a tour as an Army recruiter. Recruiters work hard, but the work is very rewarding. The service recruiters provide to our Army cannot be overemphasized.

Thank you for helping with this very important issue. We are one team.

NCOES Standards

Recently we have seen an increase in the number of unqualified NCOs who arrive at the Sergeant George D. Libby NCO Academy for Noncommissioned Officer Education System (NCOES) courses and the Drill Sergeant School. Some are overweight, cannot pass the Army Physical Fitness Test, and have "temporary" profiles. Out of 380 soldiers who came in January to attend the Primary Leadership Development Course, Basic and Advanced NCO Courses, and Drill Sergeant School classes, we had to send 50 home. This action results in wasted funds, demoralized NCOs, and vacant school seats that could have been used by fully qualified soldiers. Properly prepare your NCOs for school and check their qualifications thoroughly. We appreciate your support for this critical issue.

Great News on the Wolverine

Production of several M1A2 chassis for the Wolverine is ongoing in Lima, Ohio. In addition, bridges for these Wolverines are enroute to the factory. This critical engineer combat system is a great success story. The Wolverine's success is due to the hard work of Engineer School staff, numerous Army staff organizations, industry, and field units. Thanks to you all for a job well done.

ARMY VALUES

Selfless Service

"What you have chosen to do for your country by devoting your life to the service of your country is the greatest contribution any man could make."

President John F. Kennedy - 1961

Operation Snowbound

During the winter of 1949, the upper Plains states were hit by a blizzard of historic proportions. Snow ranged in depth from 30 to 70 inches and, driven by high winds, drifted to depths of 20 to 30 feet. The hard-hit area encompassed more than 190,000 square miles. More than 1,000,000 people and 10,000,000 head of livestock were threatened. The Missouri Division of the Corps of Engineers led the Fifth Army's "Disaster Force Snowbound." In conjunction with state and federal agencies, other services, and the National Guard, the engineers sought to clear major transportation routes, rescue trapped motorists, bring emergency supplies to isolated homes, and deliver forage for starving livestock. Battling high winds and temperatures of 35 degrees below zero, equipment operators and other staff worked 15- and 24-hour shifts. More than 2,200 bulldozers were used to clear 115,048 miles of road. Property and countless lives were saved from destruction by the deadly, frigid assault by nature.

History Office, U.S. Army Engineer School

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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

April 1999

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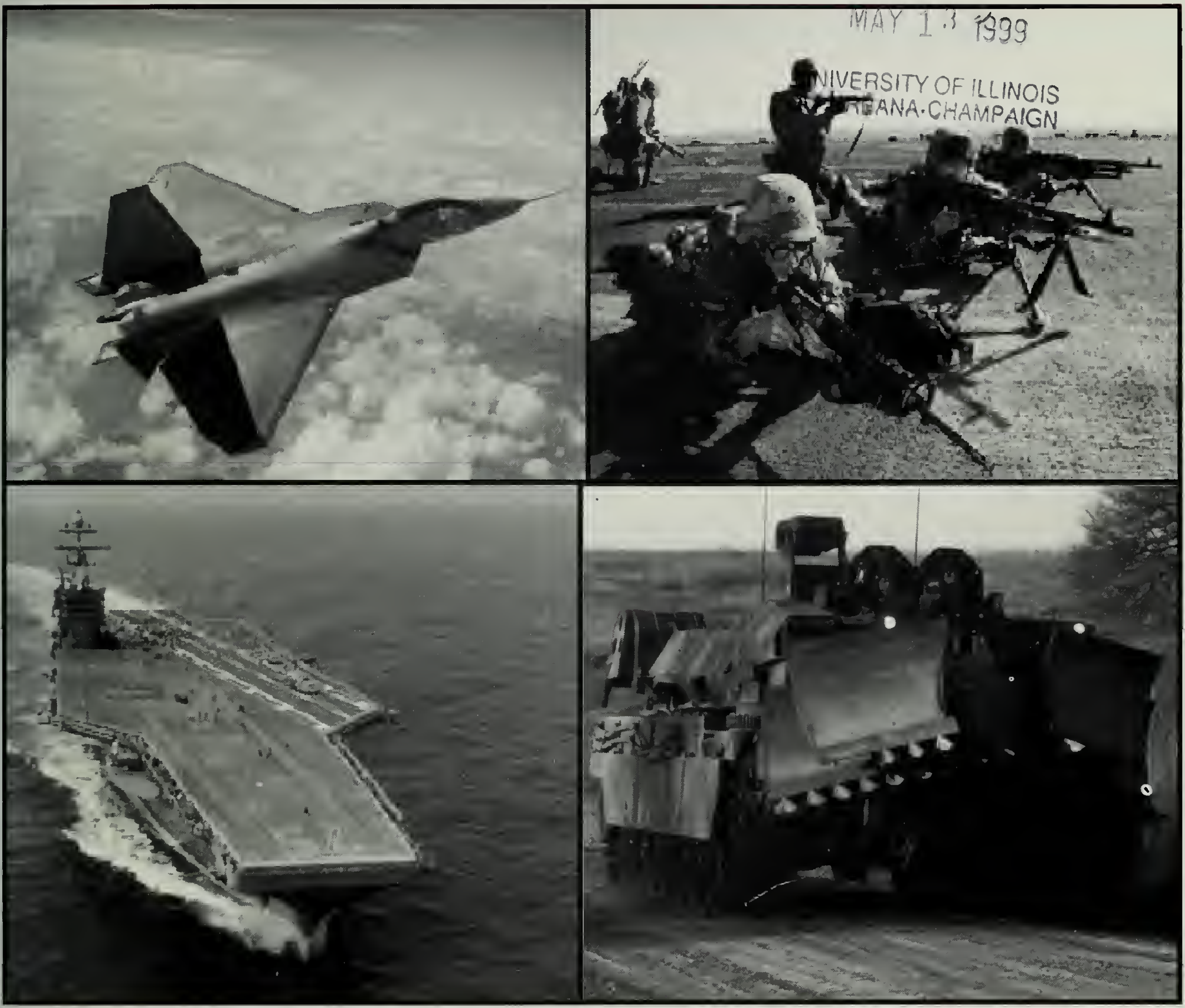
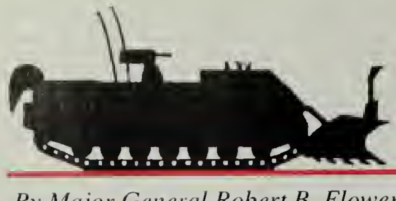


Joint Operations

Headquarters, Department of the Army
PB 5-99-2 Approved for public release, distribution is unlimited



CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

The leader's statement, "How so few can do so much for so many" is a perfect fit for the many accomplishments the U.S. Army Engineer School has managed this past year. Our community has experienced great change, not only in the myriad of tasks required for our seamless transition to the Maneuver Support Center (MANSCEN) but also in what we do best—supporting the engineer community. We will continue to march proudly into the future as we modernize our engineer force structure by synchronizing Force XXI and Army After Next efforts, complete Engineer School reorganization under MANSCEN, and continue to develop current doctrine.

Our Doctrine Division continues to work on "high priority" manuals: FM 90-13-1, *Combined Arms Breaching Operations*, FM 90-7, *Combined Arms Obstacle Integration*, and FM 5-103, *Survivability*. Furthermore, the division continues to work on Force XXI and the joint contingency force requirements. The article "Joint Doctrine Update" appears on page 24 of this magazine.

The theme for this year's ENFORCE Conference is "Joint Engineers: America's Total Engineer Force for the Next Millennium." We believe that this event has all the attributes of an outstanding conference. One of the highlights this year, presented by 1st Engineer Brigade, is a tactical twilight tattoo that outlines the rich history of the Engineer Regiment.

If you have not had an opportunity to visit our installation recently, I extend my personal invitation for you to do so. As soon as you enter the front gate, you will feel an air of vitality and energy. You will see an installation going through its maturation process as the Army's Maneuver Support Center. A $260 million construction effort on this post supports our soldiers' training needs. It leverages and synchronizes the Engineer School with the Chemical and Military Police Schools. This marriage truly passes the "common-sense test" in savings to the nation's taxpayers. The construction also supports the role these proponent schools will play in satisfying future Homeland Defense training and doctrinal requirements.

This spring, Fort Leonard Wood will reorganize to common corps subjects that will be taught by MANSCEN personnel under the Directorate of Common Leader Training. These courses include subjects that are common to all branches—for example, legal and medical courses. This will allow the proponent schools to focus training energies on branch-specific subjects. We have programmed this transition so the impact will be seamless to the engineer community at large.

In March, I had the opportunity to testify to a congressional subcommittee concerning our installation's readiness. I took this occasion to highlight our many accomplishments in 1998. Last year we trained more than 32,000 soldiers in 60 military occupational specialties (MOS) through our Basic and Advanced Individual Training, Basic and Advanced NCO Courses, Drill Sergeant School, Officer Basic and Captain Career Courses, and Precommand Courses for senior leaders. We also trained 4,000 sailors, marines, and airmen via interservice training courses. Furthermore, I extended my personal thanks to Congress for their efforts in improving our soldier's pay and retirement benefits.

Your Engineer School accomplishes all this while training and producing the finest soldiers and leaders throughout the training base. During the past two years, commanders at Fort Leonard Wood have used Army Performance Improvement Criteria principles to document and optimize their training program of instruction. After base-lining their soldiers' performance to that of other TRADOC installations, we found our soldiers set the standard in marksmanship, physical fitness training, and basic soldiers' skills testing.

Keeping my finger on the training pulse of our field units is imperative if we are to fulfill our mission at the Engineer School. I want to personally thank all of the commanders and key leaders who participated in the recent Commandant's VTC. The issues, concerns, and discussions have not fallen on deaf ears. I want you to know that we at the schoolhouse are working your issues with renewed vigor. It is our goal to meet your visions and training objectives so that engineer soldiers and leaders are trained for whatever the future may hold.

Along with all these innovations and changes come new faces and jobs. I would like to announce just a couple: Colonel Bill Van Horn will become the Engineer Assistant Commandant, and Colonel Marsha Killam will become Director of the Directorate of Common Leader Training.

We are living in a fast-paced environment. All of us at the Engineer School are committed to providing you with world-class training support. See you at the conference!

Essayons!

Engineer

April 1999 Headquarters, Department of the Army *Volume 29 PB 5-99-2*

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

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***Front Cover:** Joint operations, represented by (left to right) the U.S. Air Force, Marine Corps, Army, and Navy, ensure strong warfighting capabilities.*

***Back Cover:** Historical example of the Army value "Honor."*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER's e-mail address is: eubanksc@wood.army.mil. Our Internet home page is located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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BOSNIA:

THE SECOND TIME AROUND

By Colonel Thomas P. Bostick

LIBRARY [illegible]

The 1st Armored Division completed its second deployment to Bosnia on 7 October 1998. A number of units in the division, including the Engineer Brigade, served during various periods throughout the one-year rotation. The 16th and 40th Engineer Battalions deployed at different times during the year, and a portion of the Engineer Brigade Headquarters Company deployed for the entire year. Engineers were actively engaged in missions on two major fronts: demining and construction. The successful rotation in Bosnia was a total team effort. Army engineers worked side-by-side with Navy and Air Force personnel, civilians, Brown & Root and other contractors, NATO and non-NATO allies, and many others. This article highlights some of the missions and lessons learned throughout the deployment.

Demining

Much progress was made in moving toward the demining end state identified by the Stabilization Force (SFOR) commander: a national, sustainable demining capability. Several key elements of the campaign plan were vital to achieving this end state: organization, training, equipment, and insurance.

Organization

The organizational structure successfully transitioned from the U.N. Mine Action Center to the Bosnia-Herzegovina Mine Action Center, which includes representatives from both the Federation and Republika Srpska. This center has overall responsibility for the demining program throughout Bosnia-Herzegovina. The SFOR headquarters, through the multinational divisions, met regularly with the Entity (Federation and Serb) Mine Action Centers and the Entity Armed Forces (EAF) to determine future areas of work. Entity Mine Action Center personnel worked with EAF soldiers to determine areas of focus, while SFOR retained veto power over sites selected. SFOR soldiers monitored the EAF demining efforts. *SFOR participation in overseeing the demining process could continue to decrease with additional training for EAF monitors and quality-control observers.*

A significant challenge in achieving all the requirements set by the Dayton Accords is to complete civil implementation tasks. The military continued to provide a secure and stable environment, but the civil implementation tasks were a challenge to plan, coordinate, and execute. Demining provides a model for how civil and military tasks may work together. The U.N. Mine Action Center controlled the tasks and priorities of the civilian demining organizations, while SFOR monitored the military demining effort. Both organizations worked in parallel toward a common goal. Early in the process, the military placed a demining expert liaison officer in the U.N. Mine Action Center to help synchronize civilian and military efforts. Equally important, commanders worked at all levels—including SFOR, Multinational Division-North, and the EAF—to regularly address requirements, training, and ongoing issues. Because of the coordination between the U.N. Mine Action Center and SFOR, the demining mission could more effectively employ the efforts of multiple non-governmental and private volunteer organizations.

Training

Long-term training programs in Bosnia allowed the country to train its own deminers. U.S. Special Operations Forces (SOF) established three training centers for military and civilian deminers. The SOF coordinate many demining operations throughout the world, but combat engineers have a significant role in Bosnia. *It is important that SOF provide a liaison officer to combat engineers early in this type of mission and throughout peacekeeping operations.* Liaison officers are important to ensure a coordinated effort in key areas—such as training, funding, and equipment—so that resources are appropriately distributed among the many demining operations that require military support.

The demining challenge in stability operations requires long-term solutions. Therefore, in-theater schools that help to train the indigenous population must be established early in the campaign. Training both military and civilian deminers in Bosnia reduces the need for SFOR engineers in the training arena. Training for the civilian population in Bosnia-Herzegovina is also important. Many initiatives, including Superman comic books, were used to educate the local populace. Figure 1, page 3, shows the significant progress made in reducing mine strikes in Bosnia.

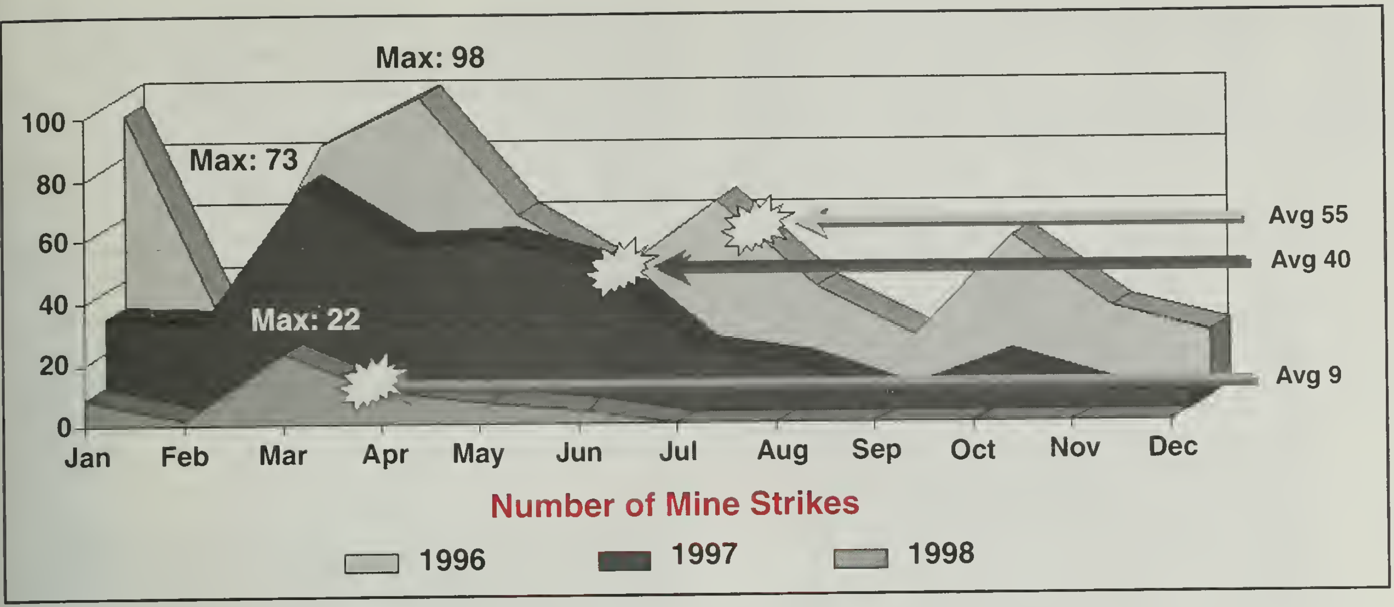

Figure 1

Equipment

SFOR purchased mechanical demining equipment similar to the U.S. miniflail for the EAF demining teams. They also acquired additional personal protective gear and mechanical demining equipment. The EAF used a small number of T55 tanks with rollers, which were particularly effective in relatively flat areas. The EAF teams were much more effective and willing to do dangerous demining work when they were properly equipped. *Providing equipment to the EAF early and establishing a regular accountability and resupply program of essential items would make it possible for their personnel to work more often and more effectively.*

Insurance

The Entity Armed Forces now have health and life insurance, which is a major improvement. Before insurance could be acquired, the EAF had to agree to several stipulations. One stipulation was to convert their mine-clearing operations to humanitarian standards. They had to perform to the same standards and use the same techniques as those used by U.N. civilian deminers. They could not continue to lift mines identified only on minefield records. The EAF successfully made this transition in July 1998, and they now focus on the amount of land cleared rather than total mines lifted. Early in the demining program, it was not uncommon for less than 50 percent of the lifting teams to arrive at work. Their reasons included pay, equipment, and insurance. Several attempts to gain funding for deminers from the international community and various countries were unsuccessful. However, insurance for deminers was very important to the EAF, and the international community supported this initiative for moral reasons. Combined with training and equipment, insurance for deminers made a huge impact on their morale and efforts. Near the end of the 1st Armored Division's year in Bosnia, 100 percent of the demining teams often arrived at work each day.

Training and organizing EAF monitors and quality-assurance officers to assume the role of SFOR monitors is a key element in achieving the end state. With proper training, the EAF can assume this responsibility and report to the Entity Mine Action Center, which will reduce the requirement for SFOR engineer monitors. The overall demining campaign in Bosnia has made significant progress. The lessons learned in organizing, training, equipping, and insuring personnel may be applicable to future operations in countries ravaged by mine challenges.

Construction

During late 1998 and early 1999, Task Force Eagle received the most significant construction mission since U.S. forces arrived in Bosnia. Some of the major projects were airfield repair, hospital construction, SEA-huts (Southeast Asia huts) for most troops, two base camp closures, and asphalt road repair. Many smaller projects were completed or are ongoing. The surge of construction was funded with a supplemental appropriation from Congress of about $34 million. Much of the construction was performed during an intensive period that also included Bosnia-Herzegovina elections and transfer of authority to the 1st Cavalry Division. The construction mission was a joint and combined effort of Army combat heavy and mechanized engineers, Navy Seabees, Air Force personnel, allied engineers, USACE, and Brown & Root contractors.

The 1st Armored Division Engineer Brigade headquarters provided command and control for both the construction and demining missions. The 130th Engineer Brigade deployed members of its construction management section and

B Company, 94th Engineer Battalion. The European District provided civilian inspectors and engineers from Corps of Engineer districts in the United States. The surgeon general's office deployed a facilities planner to assist with hospital design and construction. The Navy deployed additional design and project management engineers, and the Air Force deployed an airfield construction expert. Mechanized combat engineers worked side-by-side with Navy Seabees and Army combat heavy engineers, and USAREUR used tele-engineering to provide off-site assistance with challenging sewage and electrical power design. These teams, as well as others, were key to success. *In Bosnia, engineer teams designed and constructed several significant projects. Future operations must plan for these teams to come together quickly through a cadre of rapidly deployable experts.*

Airfield Repair

The Tuzla Airfield presented several challenges before it was completed. The most significant were funding and the need for airfield construction expertise. Task Force Eagle worked with funding constraints that were difficult to overcome in a peacekeeping mission. *Department of Defense leaders must reassess the standard military new-construction limit of $500,000 and repair limits of $2 million in terms of how they apply to peacekeeping environments.* NATO provided some funding for the airfield and may ultimately fund the entire airfield repair. SFOR, USAREUR, and U.S. Air Force in Europe (USAFE) assisted Task Force Eagle throughout the entire funding process. USAFE provided an airfield construction management expert, who was valuable in working through translators to ensure that local subcontractors met stringent standards. The result is a strategic airfield that allows soldiers to fly, for the first time, directly from the United States into Tuzla (Figure 2).

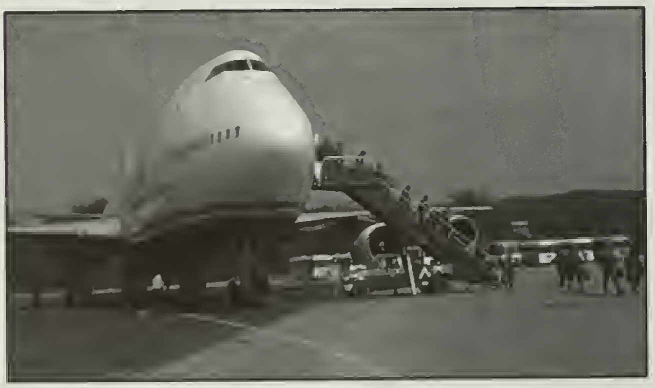

Figure 2

Hospital Construction

Another significant construction mission for Task Force Eagle was a theater-of-operations hospital, so the medical facility at Guardian Base Camp could move to Eagle Base Camp before the 1st Cavalry Division arrived. The standard theater-of-operations hospital described in the theater construction manual did not meet the strict requirements of the medical community. Therefore, the surgeon general sent a facilities planner to Task Force Eagle to assist with the hospital design. This officer was extremely helpful throughout the entire process. The team effort resulted in a new hospital that was completed on time. *Engineers must include a facilities planner early in the planning process for projects with specific design requirements.*

SEA-huts

The primary goal of this rapid construction effort was to move soldiers out of tents by the winter of 1998. Soldiers, sailors, and civilians worked together to construct SEA-huts. A new design combined five single SEA-huts side-by-side with a latrine/shower unit located between the second and third huts (Figure 3). The new design reduced fire hazards and improved quality of life for soldiers by providing a common roof, covered walkways, and nearby latrine and shower facilities.

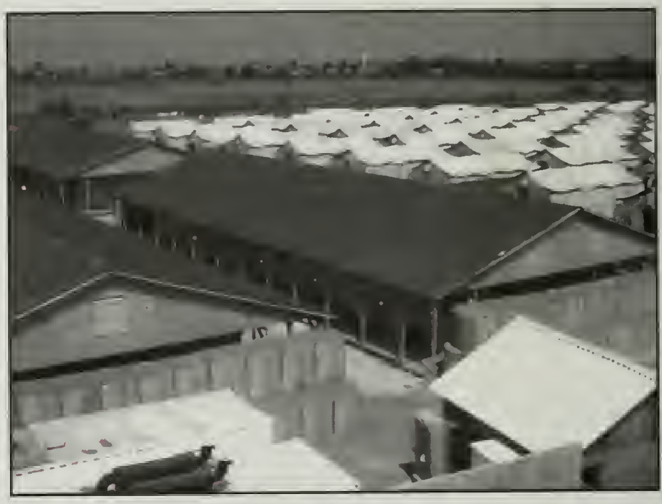

Figure 3

Base Camp Realignment

To improve efficiency, save money, and realign base camps, Task Force Eagle closed the Colt and Guardian Base Camps. These closures required that the entire logistics operations be moved from Guardian to Comanche Base Camp. A massive construction effort was required at Comanche that included living areas, a container storage handling area, a direct support maintenance building, a supply and service area building, 50-ton haul roads, a new dining facility, parking areas, and numerous other projects. Some of this construction had to be completed or be well under way so that the 1st Cavalry Division could move directly into Comanche and Eagle Base Camps.

One lesson learned during the construction mission was the synergistic effect of Navy Seabees, Army combat heavy and combat mechanized engineers, and NATO and other allies working side-by-side with Brown & Root personnel to complete a demanding construction mission.

Mechanized engineers provided much-needed manpower and dozer expertise (cross-trained armored combat earthmover operators). *In future peacekeeping operations, special construction tools not organic to mechanized engineers should be available through pre-positioned stocks.*

Task Force Eagle also benefited from theater engineer support provided by Italian rail engineers, Austrian army dump trucks, and Hungarian rail ramp expertise. These soldiers, their expertise, and their equipment were a significant force multiplier. Brown & Root personnel integrated their work with military construction efforts extraordinarily well. Military and Brown & Root planners, designers, project managers and builders worked together to make complex operations run smoothly and safely (Figure 4).

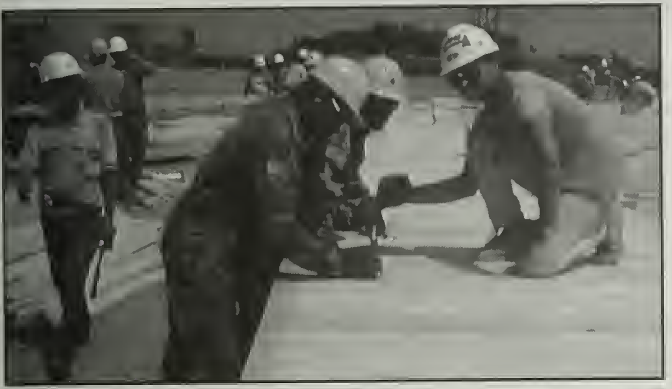

Figure 4

Other Engineer Missions

Military engineers also completed considerable work on roads and bridges off the base camps. As the SFOR mission extended throughout Bosnia, heavily used roads and bridges required significant repair. Engineers retrieved seven armored vehicle-launched bridges from Multinational Division-North routes and replaced them with timber trestle bridges. Some bridges were simple, but others were more challenging and included piers, multiple spans, steel stringers, and concrete abutments. Federation engineers (Croatians) worked with C Company, 40th Engineer Battalion, to construct the bridge shown in Figure 5.

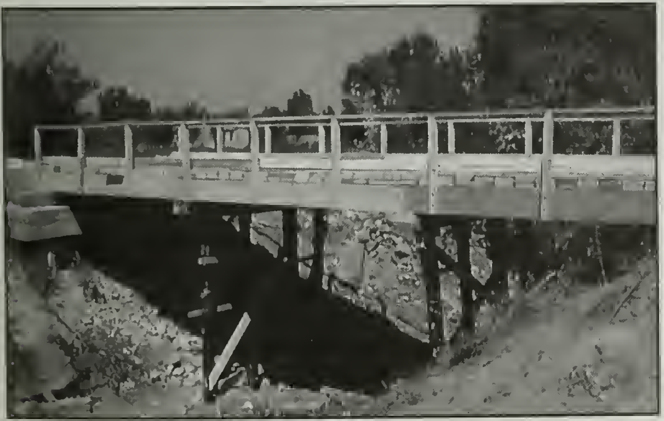

Figure 5

In some cases, military engineers demolished damaged bridges on major highways so that new bridges could be constructed. B Company, 16th Engineer Battalion, used more than 750 pounds of explosives to destroy the Bosanski Samac bridge (Figure 6).

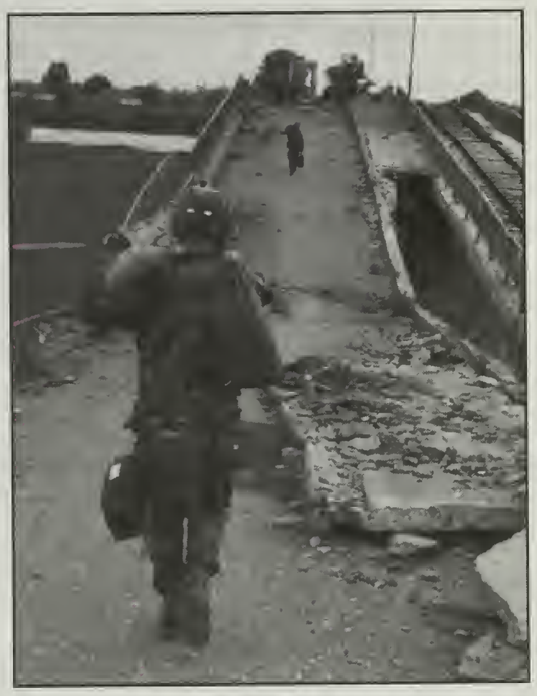

Figure 6

Task Force Eagle encouraged EAF engineers to support the democratization of their military. These engineers could help rebuild their country in areas other than demining. In most democratic countries, the military provides aid following natural disasters, and the EAF could do the same in its war-torn country. Convincing the EAF of the advantages such projects offer was initially challenging, but bridges proved to be a useful vehicle for this effort. *Building bridges benefited the local people and helped the image of the EAF military and Bosnia-Herzegovina politicians.* With the proper recognition and use of media, the joint effort with the EAF in bridge building was quite successful. Russian and American engineers worked closely with Serb engineers to complete the bridge at Priboj (Figure 7).

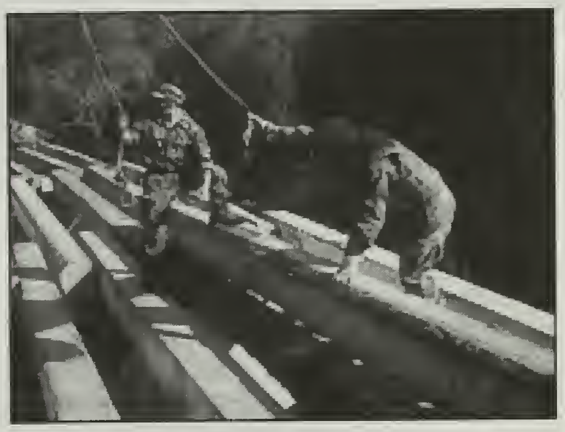

Figure 7

(Continued on page 18)

Building Bridges Between Nations

By Lieutenant Colonel William H. Haight III, U.S. Army, and Lieutenant Colonel Leonid I. Ysik, Russian Army

The 20th Engineer Battalion is a mechanized combat engineer battalion in the U.S. 1st Cavalry Division stationed at Fort Hood, Texas. The engineer battalion of the Russian Army's Separate Airborne Brigade is stationed in Stavropol, Russia. Both units are well trained, combat ready, professional, and fully prepared to answer the call to fulfill the military needs of their respective nations. Both units received that call early in 1998 to deploy to Bosnia-Herzegovina to support NATO and Operation Joint Forge.

Deployment

While preparing all the necessary logistics for the upcoming deployment, each unit simultaneously completed extensive training plans, complete with country briefings on the Entity Armies in Bosnia, force protection, mine awareness, and studies of information relevant to engineer operations in the theater. The Russians arrived in midsummer 1998 and immediately began operations in support of the Russian Separate Airborne Brigade Sector, one of four brigades in the United States-led Multinational Division-North (MND-N). The MND-N is one of three multinational divisions that make up the NATO Stabilization Force (SFOR). In September 1998, the 20th Engineer Battalion took responsibility for the U.S. brigade sector in MND-N from the 40th Engineer Battalion, 1st Armored Division, and began operations in support of the 1st Brigade Combat Team, 1st Cavalry Division.

Russian and American soldiers build a bridge at Priboj.

Joint Training

The commander of the MND-N and 1st Cavalry Division realized early in the mission the potential for combined projects with all allied nations in SFOR, but he particularly wanted to promote U.S.-Russian training and projects. Very little encouragement was needed. From the first week the 20th Engineer Battalion was on the ground, Russian and American commanders mutually agreed to make combined U.S.-Russian training a priority.

During the six-month deployment, the two battalions participated in 13 combined training or construction projects and completed planning for several more. They also visited each other's base camps to conduct NCO and officer professional development classes on topics ranging from minefield marking and recording to familiarization with former Soviet engineer equipment. Perhaps the most exciting training was a joint demolition range where soldiers from both countries demonstrated their tactical combat engineering skills. They completed a live-fire minefield breach using a Russian mini-line charge (see photo below). Additionally, both engineer battalion commanders held multiple trilateral meetings with Entity Army (Bosnian) engineers and municipal leaders concerning areas of common interest to the U.S. and Russian brigades.

Bridging Projects

Most of the combined projects, however, involved building bridges. Following up on initial coordination by the 40th Engineer Battalion, 20th Engineer soldiers and their Russian counterparts began a combined bridge-building project on the Janja River soon after arriving in country. The bridge connected Bosnian and Serb communities for the first time since the end of the war. A local village donated materials for the bridge, while SFOR engineers provided equipment support and manual labor. The result was a military load class 30 bridge that spanned a 12-meter gap and saved residents a 40-kilometer detour over very bad roads.

A total of six vehicular bridges were either completely rebuilt or resurfaced by U.S. and Russian engineers working together. The U.S. Civil-Military Commission (CIMIC) Task Force soldiers who supported the Russian Brigade sector deserve credit for helping to identify and coordinate most of these projects. In some cases, the CIMIC teams secured local funding or national assistance for materials or other support, such as welding. The CIMIC teams facilitated our engineer work by ensuring local support and approval for all plans. This was not an easy task, because most of the projects were located in economically depressed parts of Bosnia. The locals had very little to offer in return other than their gratitude.

The bridging projects were completed as military operations. Discussions for planning, design, materials, etc., were in English, which gave the Russian engineer battalion interpreters quite a challenge. Differences in planning and design factors and determining bills of material for projects made for lively planning meetings. While our approaches differed, it was very interesting to see at the end of our planning processes that the results were very similar. That surprised many engineer soldiers from both units and taught us all a lesson about the universal nature of engineer work.

Removing Barriers

Each bridge-repair mission was carefully selected to support several important MND-N objectives and to improve quality of life. While the value of these bridges in supporting freedom of movement and regenerating economic activity is very

U.S. Army engineers watch while Russian engineers use a mini-line charge to breach a minefield.

An American soldier measures a bunker.

Russian soldiers discuss bridging plans.

important, their value in terms of the message they sent is equally as powerful. The image of U.S. and Russian soldiers working together to bridge a physical gap served as a powerful metaphor for bridging other gaps, opening lines of communication, expanding cooperation, and more importantly, developing mutual understanding and trust. All this between military forces of two nations that until recently had few if any bridges between them, much less bridges that they built together. The lack of these cultural bridges contributed to the terrible war that tore Bosnia apart earlier this decade.

Perhaps the U.S. and Russian soldiers did not discuss such symbolic connections while swinging hammers and lifting heavy timbers, but you could see on their faces that they fully understood the historical significance of these events. What made all this even more rewarding was that the projects were real, affected real people, and helped countless displaced persons, refugees, and war victims begin new and better lives.

There is great value in working closely with engineers of another nation in any operation. United States-Russian cooperation was particularly important. For many years both of our armies studied each other from a distance and learned as much as possible about our mutual capabilities and equipment. The spirit of international cooperation that exists in SFOR helped both organizations set aside previously held prejudices and misconceptions.

What proved true was that both groups of engineers were skilled, motivated to complete their tasks, had dedicated competent leaders, and cared for their soldiers' training, welfare, and safety. What proved untrue were the misconceptions that for too many years created distrust and suspicion between our nations.

This experience may have been unique to our two units, but we think not. Engineers had much work to accomplish in Bosnia, and common goals have a way of removing barriers. We sincerely hope that the bridges we built together will long outlast the timber and steel structures we leave behind in the Balkan countryside.

Setting an Example

Both units trained hard for their primary missions, but neither anticipated nor prepared for a very special opportunity to conduct combined United States-Russian engineering missions in Bosnia. These missions, which were enthusiastically embraced by engineer soldiers and commanders, have produced a lifetime of memories for the soldiers of both countries. Significantly, these missions also serve as an example to the former warring factions of Bosnia, and the world, that former adversaries can forget their differences and work together toward common goals and lasting peace.

Lieutenant Colonel Haight commands the 20th Engineer Battalion.

Lieutenant Colonel Ysik is the chief engineer for the Russian Brigade in Bosnia.

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ONE REGIMENT, ONE FIGHT

By Lieutenant General Joe N. Ballard

When I was a lieutenant, senior leaders talked about branch unity. Back then I didn't really know what they meant, and frankly I didn't care. All I knew was that every time they started talking about the regiment and unity, I got a little sleepy. And I wasn't the only one. Some of the other lieutenants and captains would also start to nod. Therefore, I decided it wasn't all that important.

But this kind of attitude has led us to where we are today. If engineers don't care about the Engineer Branch, then who does?

Branch unity is not new. It has been around for decades, and it always seems to be the favorite topic of old lieutenant colonels, colonels, and generals. But to junior officers in the trenches, where the important work is done, regimental unity seems about as relevant as a glass of water to a drowning man.

During my lieutenant years, I didn't care what the rest of the Corps did. I kept my eyes on the 50-meter targets and let someone else worry about the 300-meter targets. After all, anybody who knew anything knew who the *real* engineers were. Light engineers knew *they* were the *real* engineers. So did the heavy engineers. The same was true for airborne, construction, Departments of Public Works, U.S. Army Corps of Engineers, topographic, National Guard, and U.S. Army Reserve personnel. All those engineers were in the field, where the rubber hits the road. I thought that leaders interested in regimental unity were out of touch with those who made things happen.

The 50th Engineer Company, 2nd Infantry Division, rafts Bradley fighting vehicles across a river in Korea.

Not only did senior leaders beat the dead horse of regimental unity, they frequently put a negative spin on it. The message I heard was that we needed to analyze why we were falling apart, not getting enough funding, or losing force structure. I thought it was someone else's problem, since my soldiers worked hard and did a great job. I was doing my part, and the soldiers were doing theirs. The failings were at another level. Why should I waste time and energy worrying about something that I didn't see as a problem, that I felt I could not change, and that seemed to be a lost cause. In short, *not my problem.*

Looking back, I ask myself, "What has changed?" Is regimental unity still a senior officer problem? Is it still a problem that has no solution but that everyone still feels obligated to wring their hands over? No! *Regimental unity is every engineer's responsibility.*

Many engineers do not see the value of the Engineer Regiment. They do not understand its benefits. To appreciate the value of the Engineer Regiment, we must first understand regimental unity.

"...engineers are vital to the Army and we will get the job done, but we need the funds and equipment to accomplish the mission."

Regimental unity is older than the Roman legions. Effective unity benefits the individual, the unit, and the regiment. It is the bond formed by soldiers who share a mission, share a perspective, and share hardships. The payoff is a sense of identity, camaraderie, and much greater power than can be obtained by isolated elements. If engineers want to be successful in today's resource-constrained Army, we must have our act together and act together.

Army leaders at every level must hear one coherent message from the Engineer Regiment. This message is that engineers are vital to the Army and we will get the job done, but we need the funds and equipment to accomplish the mission.

There are many steps we can take to change the culture of the Engineer Regiment. And, make no mistake, a cultural change is required. But I can't make this change alone. It takes engineers at every level to see the light and realize that the Engineer Regiment has benefits. Until this happens, senior leaders will continue to push with no true results.

A critical question is, How do we know when we have achieved regimental unity? First, we must define our success criteria. I see regimental unity as affecting three levels of the regiment: the individual, the unit, and the regiment itself.

At the *individual level*, regimental unity changes the way soldiers think of themselves. They feel that they are a U.S. Army soldier first, an engineer second, and a member of their unit third. Soldiers stick up for one another simply because they are engineers. They are brothers and sisters—family. If your engineer brethren need a piece of gear, you support them because you trust them; you know they will be there in your time of need. Soldiers at every level join professional associations that endorse and support the Engineer Regiment. This is how unity appears at the individual level.

At the *unit level*, regimental unity changes the way units interact with each other. Commanders and unit leaders emphasize our engineer heritage. Leaders make it a point to know about other elements of the regiment and teach it to their soldiers. Unit leaders defend or explain the actions of their compatriots when they hear them maligned or misunderstood. Unit leaders support the Engineer Regiment's position on issues. Every engineer looks out for each other and ensures that news—good and bad—gets passed on to someone who can act on it.

At the *regimental level*, we achieve unity when lieutenant colonels, colonels, and general officers band together to present a unified front to help each other—not only when there is a threat but also during day-to-day operations. The Engineer Regiment has never had a problem pulling together as a team during times of crisis. It's during the calm of non-emergency operations when we tend to separate. With regimental unity, senior engineer leaders insist that their units and soldiers be team players. Senior engineers network and politick with senior Army leaders for corporate positions. Soldiers and units then are provided the information and resources they need to fully function as part of the team. Engineer systems and force structure are as well-funded as combat and combat support systems. This is what I see as a unified end state.

The one-voice concept is not an attempt to keep soldiers and leaders from expressing their professional opinions when asked. But there are many sides to any important issue, and engineers should learn the merits of opposing positions. The proposal to use the Bradley as the engineer squad vehicle is a good example. Some engineers advocate using the M113A3 as the engineer vehicle, while others prefer the M2. The Engineer School has determined that the M2s are best; therefore, engineers must support this decision.

All of the above requires a concerted effort. We can't simply say that we are going to be more cohesive and then it happens. Making the regiment a viable and effective organization requires commitment from each member. Can this happen? Many people doubt it. But if Army engineers don't improve the way we do business as a regiment, then we are guaranteed to continue to decrease in effectiveness and prestige.

Okay, so why should we care about any of this? Very simply, it's not only the right thing to do, it's in your best overall interest—personally and professionally.

Most of you who read this article are trained as Army engineers. You could be assigned to an armored or airborne division, U.S. Army Corps of Engineers, Department of Public Works, or some other engineer area. Ultimately, your fate is entwined with that of the regiment. When the regiment prospers or falls, so do you. If not in this assignment, then in the next one.

Corporately, we win on issues when we band together. We lose when we don't. Whether the issue is equipment funding or fielding or force structure, the Army must see a united front from the engineer community. Because of the positions we take, when we win the Army wins.

Personally, I don't think we are doing enough to unify the Engineer Regiment. We must work together within the regiment to realize the efficiencies we gain through a coordinated effort. If the regiment applies its collective

Engineers from Alpha Company, 82nd Engineer Battalion, remove a bridge near the town of Olivo, Bosnia-Herzegovina.

knowledge and power to an issue, the results will be staggering. It only remains for us to work as a team and focus our efforts.

Okay, for argument's sake, let's say you are convinced that it is in *your* best interest and in *our* best interest to support the regiment. So why haven't we been more successful? There are two answers to this question—one easy and one hard.

The easy answer is that we haven't succeeded because we haven't tried hard enough. Everyone is too busy looking out for himself in the near term, and not enough people are paying attention to the long-term health of the entire organization. This is easily understood, because each of us has more than a full plate. We rarely have time for philosophical discussions on subjects such as regimental unity. But we must change this trend, and that will require a collective effort from the entire regiment.

The hard answer to why we haven't been more successful is that too many engineers don't see and understand the criticality of regimental unity, and senior leaders have not provided structure and discipline to the process. But we're beginning to solve this problem. We are now providing some structure through the regimental vision and a follow-on strategic plan.

To improve regimental unity, I propose the following actions:

- I want every engineer to get interested in the process—really interested—and give me some feedback. I'm designating an action officer in my planning group to keep track of regimental issues. E-mail him when there is something to report on your interaction between elements of the regiment *(kevin.porter@inet.hq02.usace.army.mil).*
- I am charging the Engineer School commandant to develop a list of engineer issues along with the proponent's recommendation and the rationale. This list of issues and solutions will be posted on the Internet. It will be sent to all commanders at battalion level and above in both the Active and Reserve Components. If you can't support the position proposed by the school, I ask you to e-mail school personnel and let them know why. That will establish critical dialogue that we need.
- I am charging my historian with developing a unified regimental history presentation. It will be available on the Internet so that every engineer has access to it. By teaching the history of our regiment and the history of the units that compose it, we will create an organization that has pride in its past. Once we share a common history, we can look toward to our common future.
- I am tasking my public affairs officer to develop a guide that shows all the major organizations in the regiment and explains their command relationships. The intent of the guide is to present in one concise document the structure of the regiment and how all the pieces fit together. The guide also will be available on the Internet. It will help engineers understand the complex and diverse nature of the Engineer Regiment.

Regimental unity is every engineer's problem. Without a dedicated effort at every level, unity cannot be achieved. Ultimately, the future of the regiment is in your hands. We can continue working in our isolated cells and performing marginally, or we can realize the benefits of applying our collective power to the regiment's problems.

I believe it's time to start moving on regimental unity. I'm ready. Are you?

Lieutenant General Ballard is Chief of Engineers and Commander of the U.S. Army Corps of Engineers. He previously served as Chief of Staff of the U.S. Army Training and Doctrine Command, Fort Monroe, Virginia. LTG Ballard is a registered professional engineer in civil engineering.

Joint Engineer Training:

Top Ten Lessons Learned

By Lieutenant Colonel Anthony Vesay

> *The nature of modern warfare demands that we fight as a joint team. This was important yesterday, it is essential today, and it will be even more imperative tomorrow.*
>
> *Joint Vision 2010*

Army and Marine Corps engineers are working together, rehearsing and synchronizing actions on the objective. Navy Seabees and Air Force RED HORSE elements join in since they'll be responsible for force bed down and ports of debarkation upgrades. This scenario is an example of joint training, right? Not necessarily.

To be considered "joint," training must meet two criteria: It must be based on joint doctrine, tactics, techniques, and procedures; and it must support or be sponsored by a joint command. In other words, the training must be in response to operational requirements established by a joint force commander. The above training may be joint. However, if it's based on Service doctrine or does not support a joint force commander's requirements, it is interoperability training. Although interoperability training is a critical part of joint readiness, it is not joint training.

This article discusses the top ten lessons learned from recent joint training exercises and missions. By presenting them here, engineers who conduct joint training or operations in the future may avoid common pitfalls and capitalize on success stories.

Hierarchy of Sources

> *The specific objective is to develop a joint training and exercise program that bolsters combatant commanders' ability to execute the National Military Strategy (NMS) while simultaneously maintaining readiness as a prerequisite to deterring aggression and responding to crises. The desired end state is improved readiness of joint forces, a training and exercise strategy better aligned with the NMS, improved interoperability, and a more stable process for optimizing the application of scarce Service resources.*
>
> *General John M Shalikashvili (Retired), Former Chairman, Joint Chiefs of Staff*

A Navy Seabee constructs SEA-huts at Camp Fairwinds, Haiti, 1995.

There is a hierarchy of sources, beginning with the National Security Strategy, that provides requirements to all combatant commanders and geographic commanders in chief (CINCs) (Figure 1, page 13). The end result of this process is joint training that is conducted in support of CINC requirements. In theory, every joint training activity conducted by military forces supports the CINC's operational requirements and is linked to the Joint Strategic Capabilities Plan, which in turn is linked to the National Military Strategy, which is derived from the National Security Strategy.

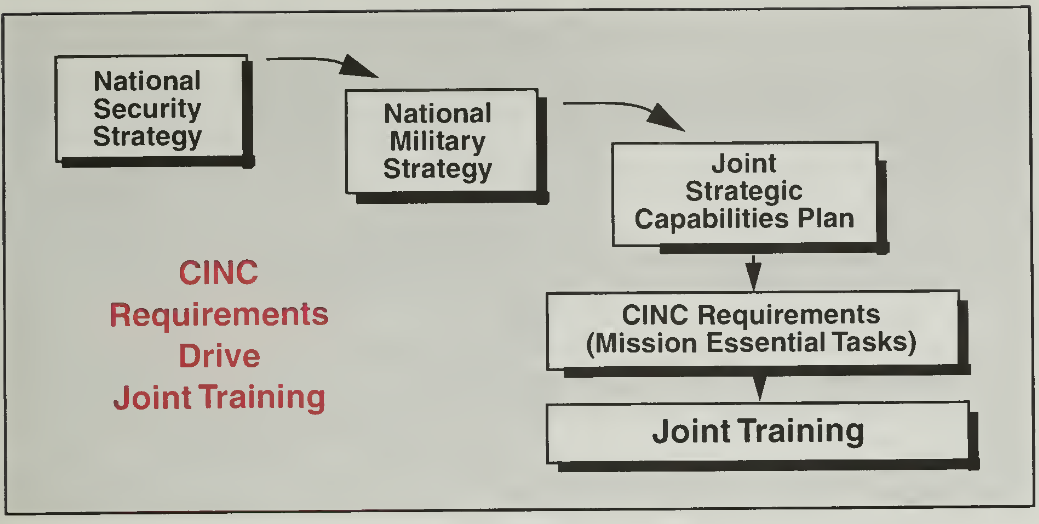

National Security Strategy
National Military Strategy
Joint Strategic Capabilities Plan
CINC Requirements (Mission Essential Tasks)
Joint Training
CINC Requirements Drive Joint Training

Figure 1

Joint Training, Analysis and Simulation Center

Joint engineer training today is primarily under the direction of the U. S. Atlantic Command (USACOM) (See article, page 19). A unified command headquartered in Norfolk, Virginia, USACOM is one of five combatant commands. Its mission, as specified in the 1993 Unified Command Plan is to—

- **Train** (meet the requirements of the supported combatant commander).
- **Integrate** (blend technology, systems, and doctrine to improve interoperability).
- **Provide** CONUS-based, general-purpose forces in support of worldwide operations (provide joint forces to supported combatant commanders as directed by the National Command Authority).

USACOM also conducts operations in its assigned area of responsibility. With components consisting of the Air Combat Command; Atlantic Fleet; Forces Command; and Marine Forces, Atlantic; it commands and controls approximately 80 percent of all military forces. (Note: According to the 1999 Unified Command Plan, USACOM will become the U.S. Joint Forces Command later this year.)

Training members of all Services to work together as one team is a major thrust of USACOM. The Joint Training, Analysis and Simulation Center (JTASC) supports the increased emphasis on simulation-based joint training. The JTASC serves as a battle laboratory that integrates and rehearses forces for employment around the world and provides a command post for use by joint task forces (JTFs). It also provides a connection to JTF components throughout CONUS. The JTASC's fully functional command center provides the JTF staff with the C4I (command, control, communication, computers, and intelligence) architecture they would use in a real-world crisis.

USACOM recognizes that not all training needs to be joint. Service Title 10 responsibilities mandate that each Service organize, train, and equip their respective forces; hence, the need for interoperability training. USACOM attempts to meld the capabilities of individual Services into a coherent, joint fighting force.

Lessons Learned

> *In December 1992, the JTF engineer approached the JTF commander of Operation Restore Hope in Somalia to obtain the commander's intent and guidance for facility and road construction. He presented multiple options with varied construction standards. Each option had an associated resource requirement affixed to the level of work and an expected completion date.*
>
> *Operation Restore Hope after-action report*

The following top ten engineer lessons learned are taken from after-action reports and observations from training events at the JTASC and recent operational deployments. Referenced deployments include operations in Central America (Hurricane Mitch), Bosnia (Joint Endeavor), Cuba (Sea Signal), Haiti (Restore Democracy), and Somalia (Provide Hope). The most recent JTASC exercise included 20 engineers from all Services. The Army-led JTF included 12 Army, four Navy, two Air Force, and two Marine engineers. Engineers who deploy in the future—whether to real-world events or exercises—can expect to face similar challenges.

Lesson 1: Engineer End State

How will we know when we're finished? If the JTF engineer has a clear vision of the engineer end state, the means to mission accomplishment will come into focus. Defining the end state and being able to articulate the means to get there will help synchronize the engineer effort. Many seemingly competing priorities will then line up accordingly.

The JTF engineer must first align the engineer end state with the overall mission or operational end state. Secondly, engineers must establish clear transition points between

Engineer Functions

J2	J3	J4	J5
Intelligence - Topography - Site surveys	**Movement and Maneuver** - Lines of communication/ Main supply routes - Intermediate staging bases - Barriers/Obstacles - Mines/Countermines **Protection** - Bunkers/Hardening - Protection **Fires** - Operational Targets	**Support** - Base development - Force bed down - Real estate management - Construction/Infrastructure repair - Facility operation and maintenance - Environmental considerations	**Plans** - Future plans - Branches/Sequels

Overarching command and control of these functions is a key to mission success.

phases, including the ultimate transition—redeployment. During Hurricane Mitch, for example, the end state was to repair or rebuild main supply routes from remote villages to the capital so market trading could continue. In Somalia, the JTF engineer defined the end state in terms of the amount of work to be done *and* the construction standards to be met. These were established early on, in line with the overall mission, which contributed to successful engineer mission accomplishment. A clear end state may not solve problems with mission creep, but it will help identify mission creep and articulate its impacts.

Lesson 2: Mission Standards

Consider force bed down. Are hardened shelters, hardback tents, or temporary shelters the standard? Standards are derived from the end state. They really are the means used to accomplish the end state and the mission. Austere conditions may evolve into initial and then temporary standards for relatively short-duration missions. More permanent standards may be appropriate for long-duration missions. The self-sustaining standards first used in Somalia evolved into temporary standards. The latter included machine-wash laundry facilities, chemical latrines, power generation, air-conditioned computer rooms, and 700 square feet of dayroom space per 100 soldiers.

The staff must establish standards before issuing orders to engineer components. It is also critical to establish consistent standards throughout the JTF; differing standards are counterproductive. Engineer boards (Lesson 6) may be used to establish consistent standards. Establishing standards drives resource requirements and makes it easier to identify the necessary capability—troop labor, contract support, or host nation—and quantities of needed resources (such as Class IV).

Lesson 3: Mission Analysis

To successfully complete mission analysis, it is critical that JTF engineers answer the question "Do the capabilities match the requirements?" The answer to this question, arrived at only through detailed analyses, dictates future actions. Requirements are the missions engineers can expect to execute—such as repairing main supply routes, upgrading port facilities, constructing refugee camps—while capabilities are the assets available. Assets include available military forces, contractors, host-nation support, and force bed-down capabilities (such as Force Provider) or prepositioned war stocks. Too often a hurried analysis leads to "crisis-action planning," where everything is critical. When that happens, the staff is in a react mode and loses control of the process. The Engineer Estimate, an internal staff product used to justify a recommended course of action, begins during mission analysis. Engineers should plan on a shortage of resources and an overabundance of missions. In other words, requirements usually will exceed capabilities.

One key to success is a clear understanding of the area of responsibility: What resources are available in theater? What capabilities must units bring? Additionally, a clear engineer end state and mission standards (Lessons 1 and 2) will help to prioritize missions and allocate scarce resources. At the end of the analysis process, the engineer cell should clearly understand who (capability) is doing what (requirement). Some form of an execution matrix that depicts mission assignments by phase is recommended.

Lesson 4: Command and Control

How should the JTF engineer organize his staff? Consider two points: First, engineers are somewhat unique in that they are involved in a myriad of functions. The table above shows some potential engineer missions that are spread across several staff directorates. Secondly, how well the JTF

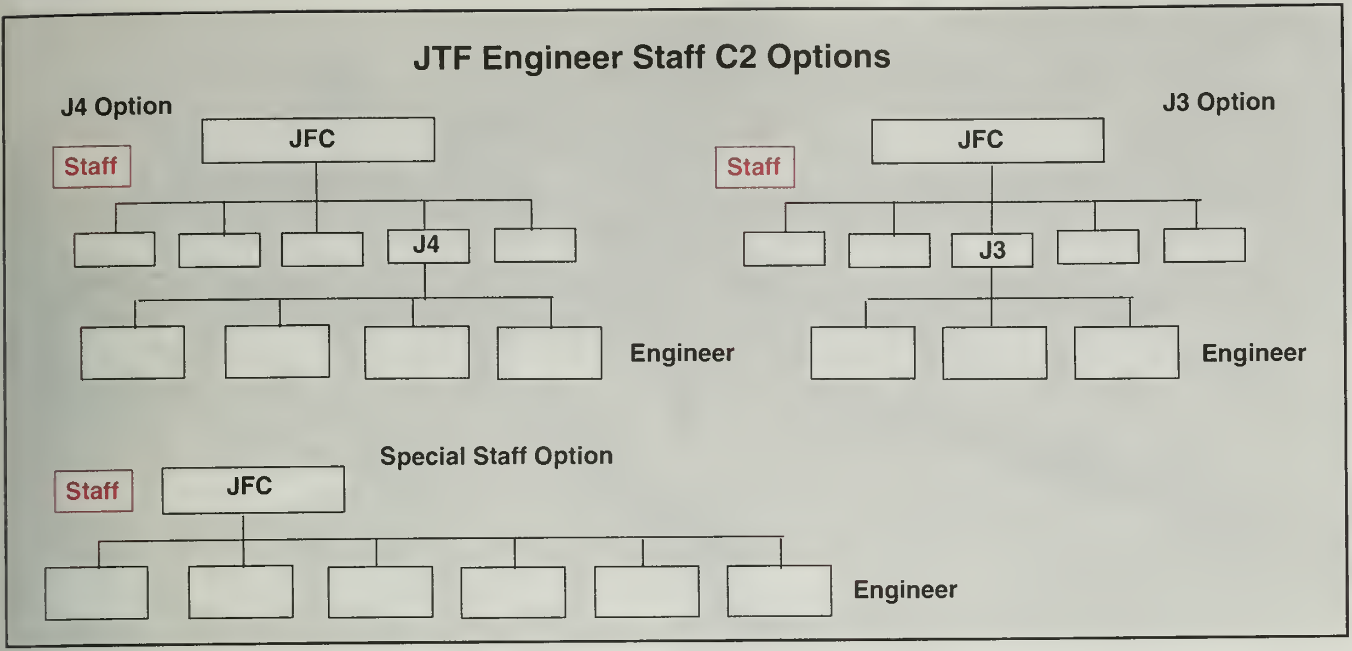


Figure 2

engineer synchronizes the engineer effort among the various staff elements often is a key to mission success. One technique is to place engineers in every directorate. For example, an engineer planner working in the J3 (Operations) directorate must communicate with engineers in the J4 (Logistics) directorate concerning proposed targeting options, since they may directly impact future operations. Likewise, an engineer in the J5 (Plans) directorate must communicate with J4 engineers concerning follow-on phases and/or future operations. And all engineers can benefit from intelligence products produced by engineers in the J2 (Intelligence) directorate.

Figure 2 shows several staff engineer organization options. Doctrine suggests that the choice relate directly to the engineer functions previously discussed. For example, if the engineer effort is operationally heavy, engineers should be under the direction of the J3; if logistically heavy, under the J4; and if the overall mission is engineer heavy, under the JTF commander (Special Staff). Remember that this is only part of the equation. The other part is component engineers, who receive and execute mission directives from the staff. Whichever option or technique is selected, the staff must plan and set the components up for success. In the final analysis, engineers should be able to draw the organizational structure. If they can, the structure is probably well understood and should result in effective mission/information flow. If they can't, there is a potential for confusion and mishandling of mission assignments and/or information.

Lesson 5: Operation Plan (OPLAN) Synchronization

In theory, engineers should receive guidance from the supported CINC's engineer staff as well as from the JTF. The former includes overarching planning considerations in the form of a Civil Engineering Support Plan (CESP), while the latter includes JTF planning guidance. With this information, the JTF engineer can issue his guidance, and the planning process—starting with mission analysis—can begin.

JTF engineers are directly responsible for developing several products, primarily a more refined CESP and the Environmental Considerations Annex. Several OPLAN appendices also require engineer input. These include Force Protection; Explosive Ordnance Disposal; Civil Affairs; Air Base Operability; and Mapping, Charting, and Geodesy. These products are described in Chairman of the Joint Chiefs of Staff Manual 3122.03, *Joint Operational Planning and Execution System (JOPES), Volume II.* Although not doctrine, engineer planners should seriously consider developing a combat engineering appendix. The Engineer Estimate process concludes with publishing the engineer products. The engineer components then write their respective plans, which should be rehearsed or "rock drilled" to synchronize the operation.

It is also important that planners clearly understand the other players—such as nongovernmental organizations and private volunteer organizations, coalition forces, contractors, and the host nation—and how they interface with the JTF (see Lesson 4). It is vital that engineer plans account for these capabilities. Failure to do so will result in duplication of effort, wasted resources, and/or mission inefficiency. Synchronization implies that a common thread runs through all plans—CINCs, JTFs, and components.

Lesson 6: Engineer Boards

Boards are temporary organizations established to solve current issues. They are comprised of key players and meet on an as-needed basis. Boards are temporary while centers or bureaus are permanent. For example, the Civil-Military

RED HORSE engineers construct Harry Truman Boulevard in Haiti during Operation Restore Democracy.

Operations Center is permanently manned and has an ongoing mission. The intent of boards is to bring in affected individuals and agency representatives from outside the engineer organization to collectively work a problem.

The JTF engineer chairs three doctrinally established engineer boards. The Joint Civil-Military Engineering Board establishes procedures, priorities, and overall direction for civil-military construction and engineering requirements in the joint operating area. Guidance from the board is used to develop the CESP. Recommended standing members include the JTF Service components, JTF comptroller, JTF staff judge advocate, J3, and J4. Others may include representatives from the embassy, public affairs office, Department of Defense real estate office, Defense Logistics Agency, and U.S. Agency for International Development. In Somalia, a joint board chaired by the JTF engineer established direction for the engineer effort and ensured that it was coordinated among the Service components before being briefed to the JTF commander.

The Joint Facilities Utilization Board evaluates and reconciles Service component requests for real estate, use of existing facilities, interservice support, and construction standards established by the Joint Civil-Military Engineering Board. In Bosnia, facility prioritization was delegated to the Army component, which evolved into the Base Camp Coordinating Agency (BCCA).

The Joint Environmental Management Board establishes policy and priorities for environmental management requirements in the joint operating area. Besides establishing engineer boards, the JTF engineer should be represented on applicable boards, such as the Joint Targeting Board. For example, engineers can offer valuable advice on the effects of a blown bridge or main supply route on future operations.

There is no requirement to establish these boards. However, if they are not established, JTF engineers must ensure that other systems are in place to solve problems. A massive fuel spill in theater, for example, needs quick action by all concerned parties. Convening a board with the key players—Service components, host nation, nongovernmental organizations and private volunteer organizations, the staff judge advocate, public affairs office, etc.—and recommending a solution probably is a better technique than directing an uncoordinated response.

Lesson 7: Future Planning

Future planning for the JTF is the responsibility of the J5, who looks ahead about 96 hours and conducts "what if" analyses. The planning team, having already developed courses of action for base operations, now conducts mission analyses and develops courses of action for anticipated branches or sequels. The planning team is assisted by the Joint Planning Group, which usually includes a core group of experienced planners augmented with individuals from other staff elements, as needed.

Executing current JTF operations is the J3's responsibility. This activity is carried out in the Joint Operations Center—the center of action for ongoing operations.

A common pitfall is that engineers often are excluded from future J5 planning and/or current J3 operations efforts. One solution is to have engineers in both staff elements. Engineers must track current operations with an eye toward future missions, particularly when significant changes in the type of mission are anticipated. Transitioning from combat operations to humanitarian assistance requires additional analysis (Lesson 3) so that appropriate capabilities are allocated to the new requirement. Too often engineers remain engrossed in the current fight and lose track of upcoming operations. When that happens, unsynchronized follow-on missions are assigned to component engineers.

Lesson 8: Resource Tracking

Engineers must track resources for military engineers and construction and barrier materials. They must be aware of all other capabilities, including contractor support. Keys to success are maintaining situational awareness (to understand how the operating environment impacts the mission) and clearly understanding the concept of operation.

The maneuver plan is the driving force behind all the other support systems. The J1 (Personnel) maintains a joint manning document that tracks individuals assigned to the JTF. The J5 manages the Time-Phased, Force-Deployment Data (TPFDD), which includes engineer unit deployment, location, and materiel shipment data. Assets may deploy by several transportation modes—air, rail, and/or ship. Engineers must maintain visibility on both the manning and TPFDD documents to ensure that the needed assets arrive when required. Engineers should arrive early if force bed-down facilities are needed at an intermediate staging base or if significant ports of debarkation upgrades are required. Engineers must understand that rapid force closure is an issue near and dear to the JTF commander. Ideally, the needed capability—people, equipment, and supplies—as determined from the mission analysis process, will arrive on time and at the right location.

Once in theater, engineers must track resources and establish information management systems. Determining specific information the joint engineer cell should track is more art than science. Component engineers usually do a fine job tracking the status of their respective operating systems and resources. *A recommendation is for joint engineer planners to track any critical theater resource common to two or more Services.* This includes Class IV and Class V scatterable mines, which are critical, high-visibility resources that usually are in short supply. Failure to centrally manage Class IV materials usually results in a "first come, first served" approach. Scatterable mines must be tracked because they are not well understood and are a continuing point of discussion (Lesson 9). Tracking the current condition of main supply routes and ports of debarkation is necessary as is tracking critical pieces of equipment, such as bridging, and contract construction information. The JTF engineer's understanding and "feel" for the operation (his situational awareness)—force protection requirements, local customs/laws, funding availability, infrastructure conditions, JTF commander priorities, etc.—ultimately determine what is tracked and reported.

Lesson 9: Rules of Engagement (ROE)

Commanders determine the rules of engagement. Legal experts obviously are involved, but commanders establish operating criteria that support their assigned mission. When developing the ROE, the JTF commander will include U.S. standing ROE (SROE) as well as applicable CINC or supplemental SROE.

Engineer involvement in ROE development centers primarily on the use of scatterable mines. Many engineers believe that to maintain flexibility, release authority for scatterable mines should be quickly pushed to the lowest permissible level. This is understandable, but the CINC and many JTF commanders have a different perspective. They want to move the operation back to the "peace" side of the peace-war continuum. Early delegation of release authority to a lower level could be interpreted as an action that moves the operation toward conflict. Although not directly related, the current policy on banning nonself-destructing antipersonnel land mines may also come into play. Usually a compromise is reached. Component engineers can usually plan for scatterable mines but should understand that they probably won't be released for execution until conflict seems inevitable. Keys to success include an understanding of the referenced debate regarding release authority, knowledge of scatterable-mine considerations—types, release authority, and general information, such as the percentage of nonself-destructing mines. Engineers typically work the ROE process with the JTF legal representative and must educate him on the proper use of scatterable mines so he can properly advise the commander.

Force protection is another operational and ROE issue that engineers must consider. Force protection is everyone's responsibility and must be embedded in mission assignments. Engineers must understand that force-protection requirements have the potential to exponentially increase theater engineer requirements and to significantly increase mission duration.

Lesson 10: Forming the Joint Team

When all is said and done, it is people—not doctrine or joint exercises—that form the essence of "jointness." There are specific criteria for joint training. The criteria are the science part; the art is formed by individuals from different Services who work together to accomplish the mission.

By definition, JTFs are ad hoc. They form for a specific mission and disband upon completion. JTFs operate primarily at the operational level of war. Their solutions are less defined than those developed at the tactical level, which is where the majority of JTF engineers are most comfortable.

Operations at the task force level are crisis action rather than deliberate, and engineers must possess three skills to succeed. The first is a thorough understanding of the engineer capabilities in one's own Service. Service doctrine and operational experiences are the key. Secondly, engineers need a working knowledge of joint doctrine. Unfortunately, Service schools already have packed curriculums and shortened course lengths and devote little time to joint training. Distance learning is one alternative for acquiring joint training. Distance learning offers engineers an opportunity to become versed in joint operations before they deploy or attend a joint exercise.

Service engineer chiefs recently approved more than 100 joint engineer core competencies. The list includes a myriad of general and engineer-specific topics, including the Goldwater-Nichols Act, Joint Civil-Military Engineer Boards, Logistics Civilian Augmentation Program capabilities, and Service engineer capabilities. The goal is to establish a joint staff web site and post briefings related to the competencies. A web site should be operational by this summer. Additionally, USACOM has posted functional area handbooks that discuss joint engineering on its home page.

The third skill is much harder to teach: the ability to be flexible and open minded, yet decisive, as a joint team member in a crisis-action environment. Recommending another Service for a mission based on an understanding of the respective capabilities is tough. Yet it is indicative of a joint team member who understands the situation.

Summary

Joint task force operations are "high adventure." The JTF engineer and his staff are presented with numerous challenges. Determining the engineer end state and mission standards, conducting proper mission analyses, choosing the appropriate command and control structure, and synchronizing the engineer effort during the planning and execution phases are just a few of the challenges they face. Engineers do all this in a crisis-action environment—very likely in a foreign country without needed resources and with team members who probably are meeting each other for the first time.

The lessons presented here will help the engineer staff learn from others' experiences. And hopefully, they will not have to be re-learned.

Lieutenant Colonel Vesay is an Army engineer assigned to U.S. Atlantic Command. He is the senior engineer observer/trainer, responsible for training engineer forces to operate within a joint task force. He is scheduled to command the 249th Engineer Battalion this summer.

(Continued from page 5)

Task Force Eagle engineers worked with the U.S. Agency of International Development (USAID) as well as politicians from the United States and Bosnia-Herzegovina to accomplish engineer tasks that supported the overall campaign plan. The joint efforts of Ambassador Farrand (supervisor of Brcko), MG Ellis (Task Force Eagle commander), and USAID leaders to construct a water well for a village near Brcko demonstrated the type of missions that engineers can assist with during stability operations. Army engineers—working with the ambassador's office, USAID, and the two mayors (Federation and Serb) of the town of Stari Rasadnik—helped push through the design, approval, and groundbreaking of the well, which provided much-needed water for the people (Figure 8). *Military engineers in peacekeeping operations must understand how key organizations such as USAID can assist in the overall campaign plan.*

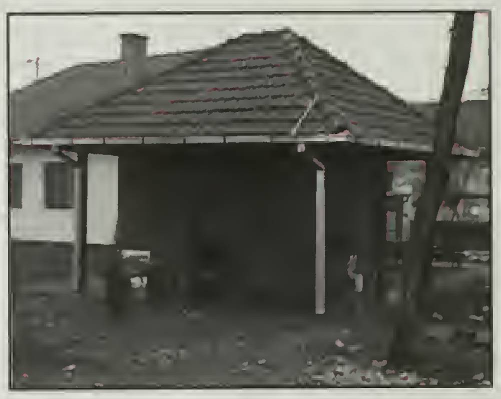


Figure 8

Teamwork

Engineers in Bosnia-Herzegovina often worked side-by-side with engineers from many other countries. Each country adds value in various areas that help the overall mission. *To form a strong and effective team, U.S. engineer planners must clearly understand the capabilities of our allies.*

Bosnia provides another great opportunity for military engineers from around the world to serve their respective countries. MG Ellis' vision, appreciation, and support of engineers fueled an enormous effort. The 1st Armored Division Engineer Brigade was honored with the opportunity to serve in Bosnia. In November 1998, we handed off the torch to a well-prepared 1st Cavalry Division Engineer Brigade. They are continuing a great tradition of engineers serving our nation whenever and wherever they are needed.

Colonel Bostick is the 1st Armored Division Engineer Brigade commander. Previous assignments include engineer battalion/brigade S3, 1st Armored Division; and commander, 1st Engineer Battalion, Fort Riley, Kansas.

The USACOM Joint Warfighting Center

By Major General Martin R. Berndt and Colonel John A. Clauer

The Goldwater-Nichols Act of 1986 highlighted the importance of joint operations to national security and the critical need for joint training for our armed forces. The joint operations envisioned by drafters of this legislation now are becoming a reality. At the heart of this improved joint capability is the U.S. Atlantic Command (USACOM) Joint Warfighting Center (JWFC)—an organization dedicated to comprehensive and integrated joint training.

As commander of the Joint Warfighting Center, it is my privilege to lead a team of nearly 200 dedicated military and civilian personnel and more than 400 supporting contractors employed in training, modeling and simulation, doctrinal and information distribution, and data-collection duties. How well the center accomplishes these tasks depends on the military community's understanding of the center's mission, knowing what services it offers, and knowing how to request those services. This article describes the Joint Warfighting Center and its capabilities to support joint engineer training.

History

The new USACOM Joint Warfighting Center was established on 1 October 1998, by combining the old JWFC at Fort Monroe, Virginia, with the USACOM J7 and its Joint Training, Analysis and Simulation Center (JTASC) in Suffolk, Virginia. The new organization integrates training and learning to support both CONUS and OCONUS joint forces. The USACOM JWFC retains its central role in conceptualizing, developing, and assessing joint doctrine. It also harnesses modeling and simulation tools and evolving information technology to provide comprehensive training support to commanders in chief (CINCs), Services, agencies, and organizations throughout the joint community. The center's mission is to—

- Support joint and multinational training and exercises for commanders, staffs, and component forces.
- Help the Chairman, Joint Chiefs of Staff (CJCS); CINCs; and Service chiefs prepare for joint and combined operations.
- Assist the CJCS in the conceptualization, development, and assessment of joint doctrine.

Joint Training

Before the USACOM JWFC was formed, the USACOM J7 at JTASC conducted three or four large distributed exercises each year. These exercises had 550-3,000 participants, lasted 17-24 days, and focused primarily on operational warfighting training at the joint task force level. The old JWFC at Fort Monroe supported about 12 deployed "full package" exercises each year that had 150-1,000 participants and lasted 17-24 days. These exercises were conducted primarily in theater for regional CINCs and focused on preparing for likely contingencies.

The new USACOM JWFC supports or conducts 15 "enhanced" major exercises annually. However, the focus is not on how many exercises we churn out but on the effectiveness of that training.

Fuertes Defensas 98-99

A recently completed exercise called *Fuertes Defensas 98-99* demonstrates the combined capabilities of the new JWFC. This multiechelon exercise combined a CINC (U.S. Southern Command) battle staff exercise with a joint task force (XVIII Airborne Corps) event. It incorporated the educational portion of the Army Battle Command Training Program from Fort Leavenworth, Kansas, with an Army Warfighter evaluation of the XVIII Airborne Corps' Army element. Combining various elements of Service and joint community training programs is referred to as "nesting" exercises.

The capstone element of Fuertes Defensas 98-99 was JWFC exercise program support deployed to the CINCSOUTH headquarters in Miami, Florida. Personnel in Miami helped to design, plan, execute, and assess this joint training event, which focused on a scenario from the U.S. Southern Command theater. They helped the CINC select a joint mission essential task list to support training objectives, identified the training audience, assisted with the scenario and exercise planning, provided the joint exercise control group, controlled exercise execution, and facilitated after-action review. In Fuertes Defensas 98-99, this capability was

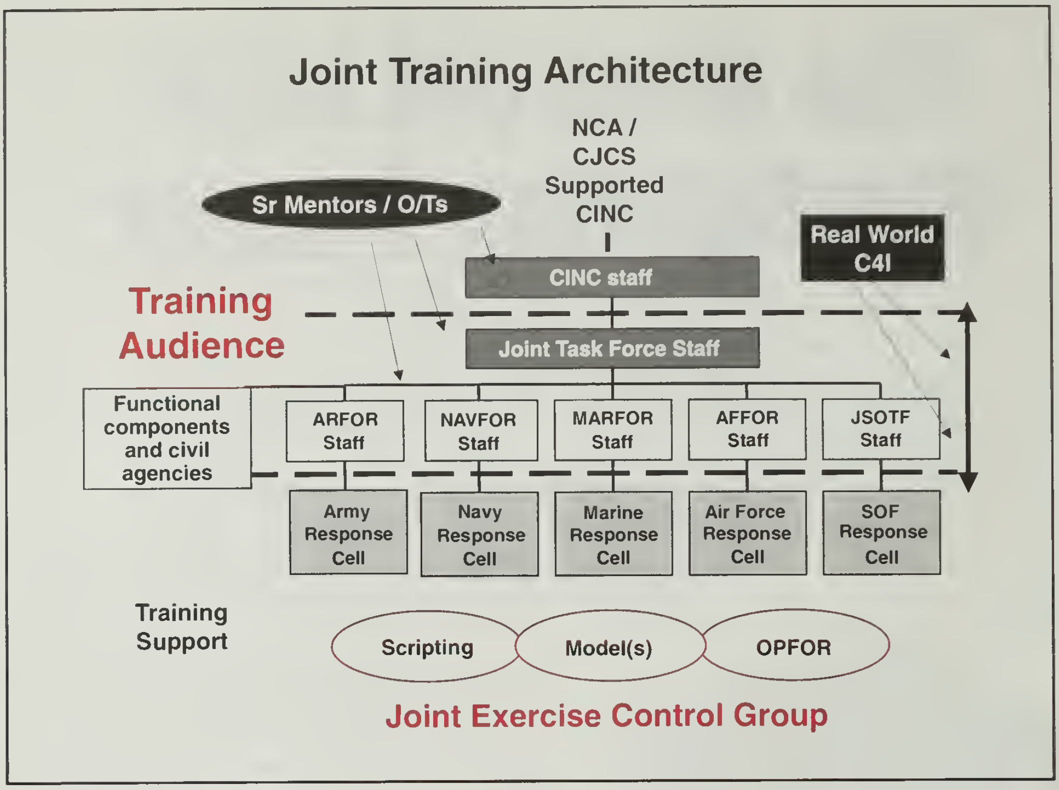


Figure 1

linked, through modeling and simulation, with schoolhouse training provided for the XVIII Airborne Corps at the JTASC. The JTASC used the following four-phase training cycle:

- Academic training
- Planning and development of the operation order
- Execution of the Joint Training Confederation (JTC) computer simulation model
- After-action review

Figure 1 shows generic joint training architecture.

During Fuertes Defensas 98-99, the Suffolk, Virginia, and Miami, Florida, training sites were augmented by elements at component headquarters and other sites across the eastern half of the United States and at Davis Monthan Air Force Base in Tucson, Arizona (Figure 2, page 21). These elements were linked by traditional military C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) systems. While planning and executing the exercise, commanders and staffs were linked by video teleconferencing as well as liaison officers. The Joint Center for Lessons Learned (JCLL), another element of the JWFC toolbox, helped evaluate the exercise and prepare the after-action report.

Merging capabilities to develop a multiechelon exercise typifies the training we hope to conduct. Merging capabilities will enhance the effectiveness of training and help reduce operational tempo. We will provide improved academic support, improved and streamlined computer simulation models, more effective lessons learned, and emphasize the distribution of systems via deployed exercise support.

The following elements of the new enhanced training program also deserve mentioning:

Worldwide Scheduling

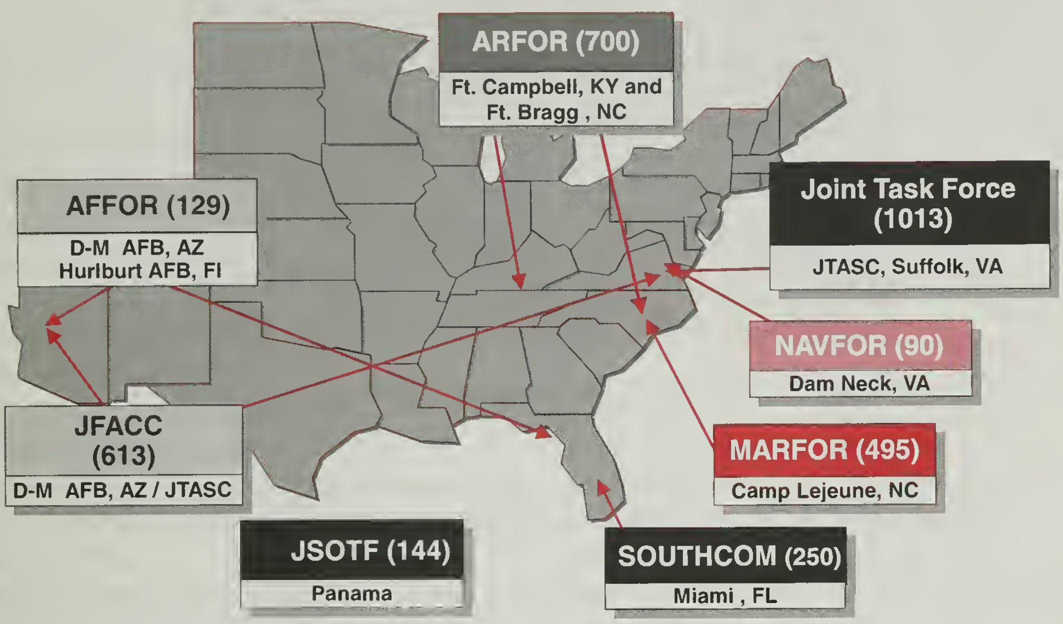
A new JWFC mission is to coordinate, deconflict, and rationalize the scheduling of exercises and training events. One way to improve training efficiency is to "nest" exercises. Another method is to combine similar or duplicated CINC and Service training and exercise programs. The JWFC uses computer-assisted scheduling tools to identify inefficiencies in the scheduling process.

Joint Training System Support

JWFC teams train the CINC staffs on the Joint Training System and help develop documents required by the system, including joint mission essential task lists and training plans. The teams also review and update the universal joint task list, which is the basis for developing the CINC task lists and is a reference used to create training plans. Mobile training teams provide classroom instruction on the Joint Operation Planning and Execution System and joint doctrine required for deliberate or crisis-action planning for major exercises. They also assist with short-notice planning and operations during real-world contingencies.

FD 98 CINC's Battlestaff and JTF Training

Distribution of Models and Simulation; FUERTES DEFENSAS 98/99..."AN EXAMPLE"



Figures in parentheses are numbers of people in the exercise.

Figure 2

Joint Center for Lessons Learned

The JWFC has refined the JCLL database of more than 8,000 entries to about 1,800 relevant lessons learned. They also provide a database search engine and analyst support. The JCLL works with the Center for Army Lessons Learned Collection and Observation Management System to develop collection tool software, which is scheduled for fielding in FY99. Using JCLL analysts as collection agents significantly improves the after-action products we provide. JCLL is a Secret Internet Protocol Router Network (SIPRNET)-based web tool available to all agencies with registered SIPRNET access. JCLL may be accessed at *jcll.jwfc.acom.smil.mil.*

Joint Distributed Learning Center

This web-based tool is available to Unclassified-but-Sensitive Internet Protocol Router Network (NIPRNET) military address users. It contains programs taught at the JWFC, links to related doctrinal and reference material, the Joint Task Force Commander's Handbook, and other handbooks on joint topics. It can be accessed from the JWFC home page at *http://www.jtasc.acom.mil.* If denied access, call the JWFC at DSN 668-7266 for a password.

Modeling and Simulation Support

As the military moves into the 21st century, two problems will affect training: personnel tempo and the high cost of manpower- and resource-intensive exercises. Large exercises such as Ocean Venture or Solid Shield have traditionally cost upwards of 800,000 man-days and $40 million. By using innovative modeling and simulation tools, we can provide the same level of training for commanders and other leaders for about 80,000 man-days and $3.5 million—a 90 percent reduction in cost and personnel tempo (Figure 3, page 22). This method of training allows Service forces and unit commanders to focus on tactics, techniques, and procedures rather than function as a training tool for the joint force commander, component commander, and staffs. The key to JWFC's successful training programs is effective use of the following modeling and simulations systems:

Joint Theater-Level Simulation (JTLS)

The JTLS model facilitates training in simulation-supported events at strategic theater and operational levels of war. The simulation is a single model that can display forces in an aggregate format. It is widely used to support multidimensional conventional warfare, military operations other than war, and coalition warfare. Several fully qualified JTLS database builders, technical operators, and instructor/controllers provide training on the simulation and oversee simulation operations.

Joint Training Confederation (JTC)

This model combines several Service models that interact and operate within the Aggregate-Level Simulation Protocol System. It supports CINC and joint task force simulation-

Joint Training Man-Day Comparison

Field Training Exercises	Computer-Assisted Exercises
Ocean Venture-- 840,000 man-days	Unified Endeavor-- 80,256 man-days
Solid Shield-- 390,620 man-days	Agile Lion-- 10,934 man-days
Cost ~ $ 37M	Cost ~ $ 3.4M

Figure 3

supported training, primarily at operational levels of warfare. While well-planned exercises using the JTC can be effective, they usually require numerous support personnel, role players, and event scriptors, as well as large control groups. However, the JTC displays forces at the smallest unit level and provides simulation support for detailed training objectives by functional and Service components of a joint task force. The JTC is used by the JWFC in CINC and joint task force training from the Joint Training, Analysis and Simulation Center.

Other Modeling and Simulation Programs

The USACOM JWFC also supports the following emerging modeling and simulation programs:

Joint Simulation System (JSIMS). This system eventually will replace the JTLS and JTC. It will support joint and Service training requirements from strategic national through tactical levels, across the full spectrum of warfare operations. JSIMS is a joint, Service, and interagency cooperative development effort.

When JSIMS reaches its initial operational capability in April 2001, it will replace the Joint Training Confederation. It will have a strategic theater and operational focus. By full operational capability, anticipated in December 2003, JSIMS will replace all joint legacy simulation models. It will support the full range of universal joint and Service tasks.

Joint Conflict and Tactical Simulation (JCATS). This is a multisided, interactive, high-resolution, entity-level simulation for training, analysis, mission planning, and rehearsals. It displays simulations down to individual combatants in single buildings or combat vehicles. It supports military operations other than war, military operations in urban terrain, special operations, conventional ground combat operations, and mission rehearsals. JCATS, Version 1.1, fielded 30 October 1998 by Lawrence Livermore National Laboratories, has robust joint and urban features that no other simulation possesses. JCATS, Version 1.2, released in December 1998, has even greater resolution and fidelity. JCATS is evolving as the common simulation for joint experimentation applications in Service Battle Laboratories.

Joint Integrated Database Preparation System (JIDPS). This system reduces the time and manpower required to build databases and conduct database tests for simulation-supported exercises.

Joint Doctrine

An essential piece of any training program is the doctrine used for force employment. The CJCS Joint Doctrine Program helps the Services and joint community conceptualize, analyze, develop, disseminate, assess, and revise current and future joint doctrine, tactics, techniques, and procedures. By having the CJCS's day-to-day manager of the Joint Doctrine Program collocated with the joint training processes, we have established a cycle of input and output of doctrinal ideas from all training and exercise events.

The JWFC provides worldwide support to all CINCs, Services, and Joint Staff as the "honest broker" in joint doctrine. Our role, as described in Joint Publication 1-01, *Joint Doctrine Publication System*, has three primary responsibilities:

- Write joint doctrine.
- Coordinate with other activities that are tasked to write joint doctrine.
- Disseminate and integrate doctrine into the training and exercise program.

Whether writing joint doctrine or supporting others who write it, the JWFC accomplishes the same key tasks during doctrine development. These include:

- Analyzing new doctrine proposals.
- Developing directives that outline the structure of new publications.
- Hosting working groups to discuss publications.
- Coordinating and commenting on publication drafts.
- Assessing all approved publications.
- Revising these publications when necessary.

A critical JWFC role in the doctrine process is to assess current joint publications. Blessed with officers from all four Services who possess a broad range of military skills, we identify and address shortcomings in joint publications, inconsistencies between similar documents, and voids in the doctrinal library. We also assess the overall readability of publications and ensure that training processes are consistent with joint doctrine. Finally, we observe the application of doctrine during training events.

JWFC personnel help the Joint Staff J7, Joint Education and Training Division, to certify and accredit joint professional military educational institutions.

The USACOM JWFC Joint Doctrine Division and its electronic library may be accessed on the NIPRNET at *http://www.dtic.mil\doctrine*. This site allows access to all approved joint doctrine tools and sites.

Emerging Systems

The following emerging systems will support joint training:

Distributed Joint Training Initiative

A new initiative within the Joint Warfighting Center is our involvement in distributed joint training. As the Chairman of the Joint Chiefs of Staff expressed in Joint Vision 2010:

> *"Simulations must be interconnected globally—creating a near real-time interactive simulation superhighway between our forces in every theater. Each CINC must be able to tap into this global network and connect forces worldwide that would be available for theater operations. This network will allow selected units in CONUS to train with forces located in an overseas theater without actually deploying there."*

The vision of this program is to establish global distributed architecture that integrates and shapes related Department of Defense initiatives, programs, and operational requirements. It will link Service and joint programs and provide the capability for worldwide warfighter participation in joint training on demand. This program will become the means for distributing training, as envisioned in Joint Vision 2010.

A single program that provides rigorous, high-fidelity training and training support

Joint Exercise Management Package

Joint Exercise Management Package (JEMP) III will provide automated support for the joint training system. When complete, the JEMP III will have four modules, one to support each phase of the system. The Mission Requirements Module and the Mission Planning Module are in place, and the Mission Execution and Mission Assessment Modules are being developed. The Mission Requirements Module identifies CINC mission requirements and helps develop the CINC's joint mission essential task list. The Mission Planning Module automates development of all required tabs of the CINC's Joint Training Plan. When the four modules are complete, the system will provide a range of database information to manage the CINCs' training programs.

The Road Ahead

The JWFC is a growing organization that is involved in almost every aspect of joint training. It is more than a conglomerate of programs and systems. The JWFC is a dynamic organization that enhances the U.S. military's ability to conduct coherent joint operations through the synergistic effect of training support, modeling and simulations, doctrinal services, and distributed learning and training technologies. Our role in these programs and our innovative use of emerging information technologies places us on the cutting edge of joint training. I encourage you to contact us on our NIPRNET and SIPRNET web sites and to use the services and products that we provide.

Major General Berndt is commander of the Joint Warfighting Center, Fort Monroe, Virginia, and the director for joint training (J7), USACOM, Norfolk, Virginia. He previously served as deputy commander, U.S. Marine Corps Forces, Atlantic; and with the Office of the Joint Chiefs of Staff and Headquarters, U.S. European Command.

Colonel Clauer is the deputy director of the Joint Training, Analysis and Simulation Center of the Joint Warfighting Center, Suffolk, Virginia. He previously served as head of the Concepts Division at JWFC, responsible for concept development and implementation of Joint Vision 2010.

Joint Doctrine Update

By Major Scott Spellmon

Several engineer-focused joint publications (JP) are in the doctrine development, revision, and approval process. They are JP 3-34, *Engineer Doctrine for Joint Operations*; JP 4-04, *Joint Doctrine for Civil Engineering Support*; and JP 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare*. These publications, among several others, present doctrinal discussion for the engineer battlespace functions outlined in JP 3-34 (general engineering, topographic engineering, and combat engineering) as depicted in Figure 1.

This article provides an update on where these publications are in the development process. It discusses significant content revisions that have been drafted as a result of lessons learned from recent operations and presents the method by which the Army and joint publications hierarchy will be linked in the near future.

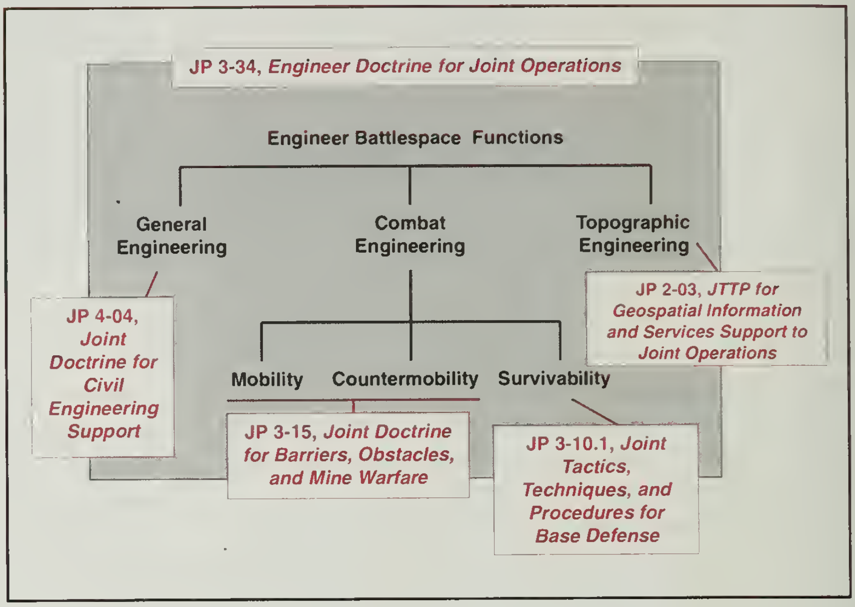

JP 3-34, *Engineer Doctrine for Joint Operations*
Engineer Battlespace Functions
General Engineering
Combat Engineering
Topographic Engineering
JP 4-04, *Joint Doctrine for Civil Engineering Support*
JP 2-03, *JTTP for Geospatial Information and Services Support to Joint Operations*
Mobility
Countermobility
Survivability
JP 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare*
JP 3-10.1, *Joint Tactics, Techniques, and Procedures for Base Defense*

Figure 1. Engineer battlespace functions

JP 3-34

A new publication, JP 3-34, *Engineer Doctrine for Joint Operations*, will serve as the capstone manual for joint engineering. It will provide joint force commanders and their staffs with guidance, principles, and procedures to plan, coordinate, and conduct timely and tailored joint engineer support across the full range of military operations. This publication will fill a void in today's joint doctrine library, since there is no manual that ties together the engineer battlespace functions or describes how they shape the battlespace in which joint forces will operate. In comparison to U.S. Army doctrine, JP 3-34 is the "FM 5-100, *Engineer Operations*" of the joint community.

Highlights of the publication include considerations for two of the most debated issues within the joint engineering community: placement of the engineer staff within the joint staff structure and command and control options for the joint engineer force. JP 5-00.2, *Joint Task Force Planning Guidance and Procedures*, states that "The commander, joint task force (CJTF) may organize his staff as he considers necessary to carry out his duties and responsibilities...." Given this capability, Chapter II of JP 3-34, "Command and Control," presents several staff placement options for the CJTF to consider when organizing his engineer staff for a particular operation (Figure 2, page 25). Since many engineer staffs within today's joint commands are subordinate to the J4, the intent of this discussion is to present the considerations and benefits for locating the engineer staff outside of the logistics function. JP 3-34 describes advantages of placing the engineer as a special staff officer (with staff links to the J3, J4, and J5) or as a cell under the J3, depending on the nature of the operation. In many operations, these options offer the engineer staff more opportunities to optimize their functions and facilitate planning and coordination issues related to operational maneuver, force protection, or other engineer-intensive mission requirements.

Command and control options for the engineer force traditionally have been established along Service lines as a Service component command (top portion of Figure 3, page 25). While this technique remains an option, JP 3-34 presents other command and control courses of action for the joint force commander to consider when organizing the joint force for an operation. In light of recent operations, a functional component command may be more efficient to leverage the unique engineering capabilities within each Service (bottom portion of Figure 3). For example, in some operations the joint force commander may best optimize Marine and Army

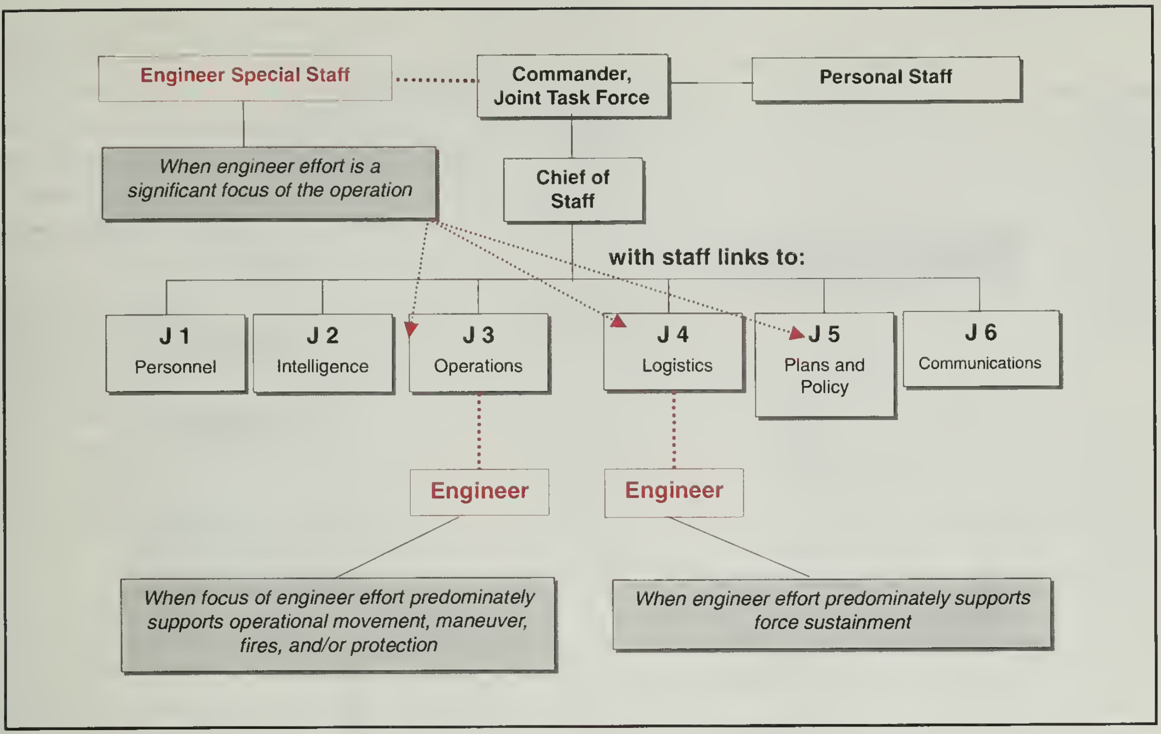

Engineer Special Staff
Commander, Joint Task Force
Personal Staff
When engineer effort is a significant focus of the operation
Chief of Staff
with staff links to:
J 1 Personnel
J 2 Intelligence
J 3 Operations
J 4 Logistics
J 5 Plans and Policy
J 6 Communications
Engineer
Engineer
When focus of engineer effort predominately supports operational movement, maneuver, fires, and/or protection
When engineer effort predominately supports force sustainment

Figure 2. Sample JTF HQ staff organization with engineer staff placement options.

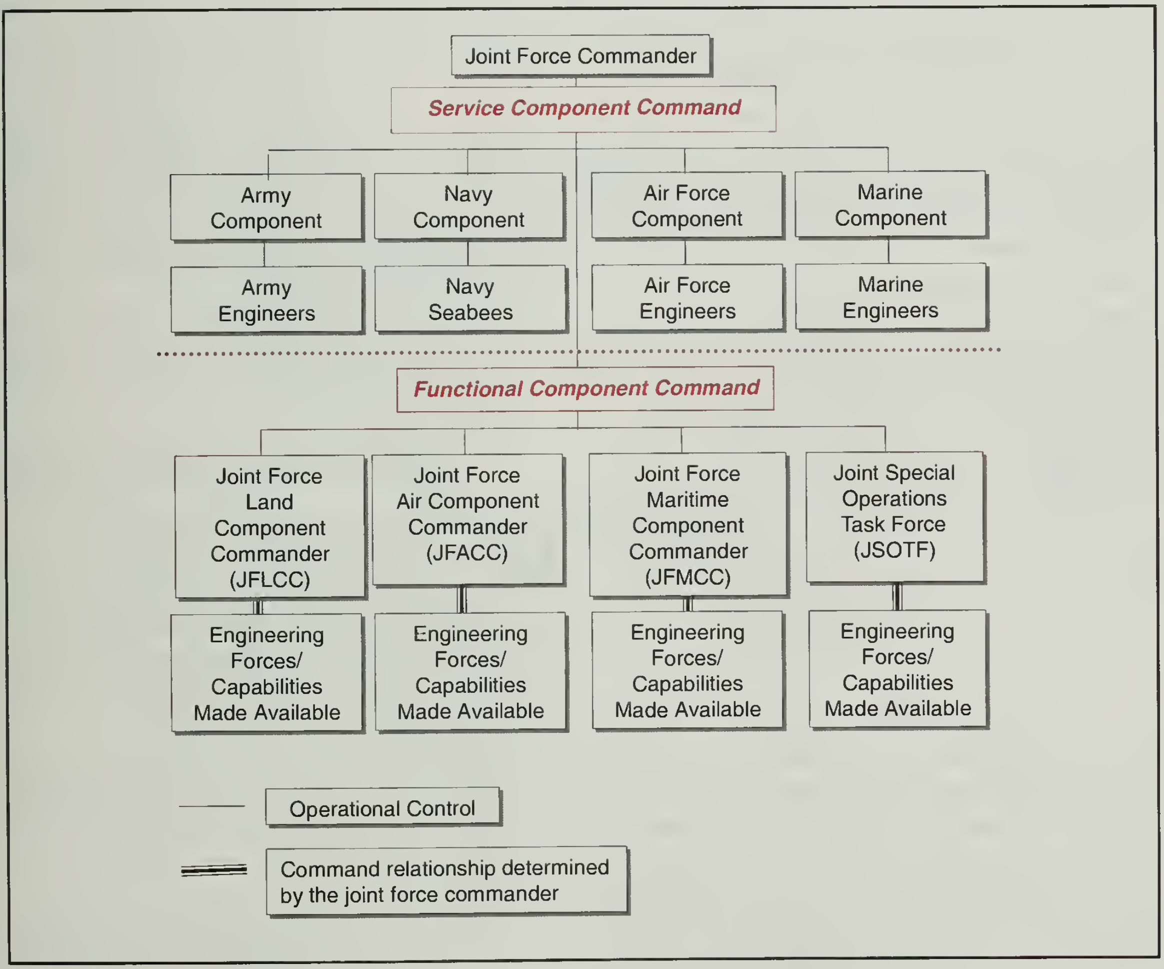

Joint Force Commander
Service Component Command
Army Component
Navy Component
Air Force Component
Marine Component
Army Engineers
Navy Seabees
Air Force Engineers
Marine Engineers
Functional Component Command
Joint Force Land Component Commander (JFLCC)
Joint Force Air Component Commander (JFACC)
Joint Force Maritime Component Commander (JFMCC)
Joint Special Operations Task Force (JSOTF)
Engineering Forces/ Capabilities Made Available
Engineering Forces/ Capabilities Made Available
Engineering Forces/ Capabilities Made Available
Engineering Forces/ Capabilities Made Available
Operational Control
Command relationship determined by the joint force commander

Figure 3. Service and functional component commands

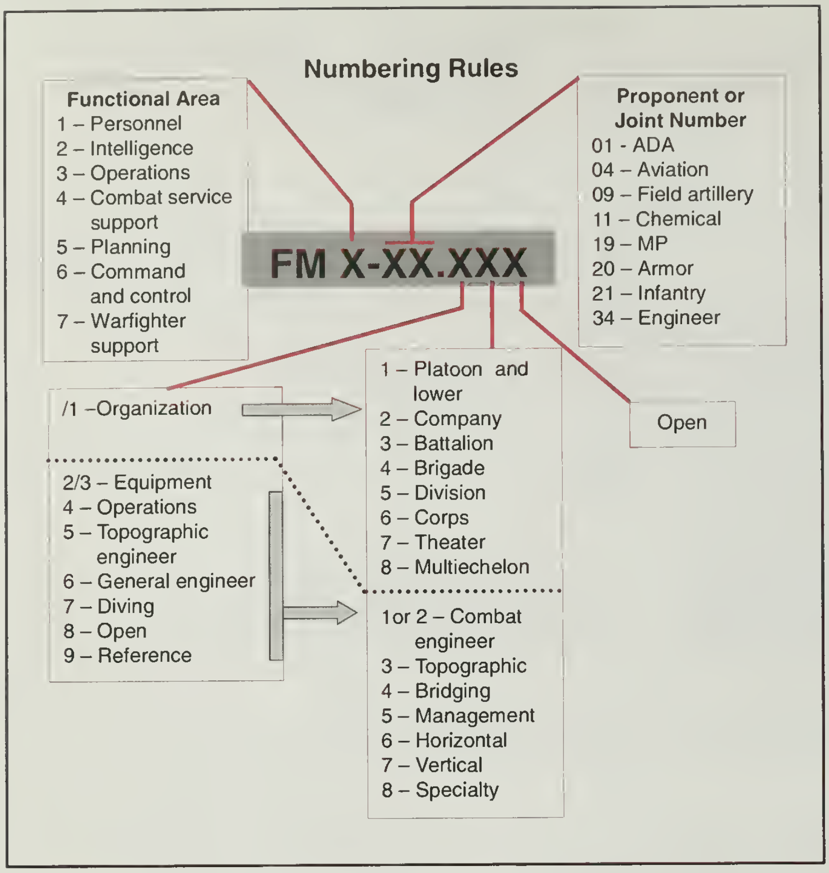


Figure 4. Numbering rules

engineers by making them subordinate to the joint force land component commander, leaving Air Force engineers subordinate to the joint force air component commander and Navy Seabees subordinate to the joint force maritime component commander. This is one example; JP 3-34 presents numerous options that are available when engineers are organized under a functional component command. The publication also presents considerations the staff should address when preparing task organizations and command or support relationships for a given joint operation.

U.S. Army Engineer School personnel participated in recent working groups to develop JP 3-34. As lead agent, the U.S. Army Training and Doctrine Command (TRADOC) will distribute this publication to the commanders in chief and Services for final review in May 1999.

JP 4-04

The key "4-series" joint engineer publication is JP 4-04, *Joint Doctrine for Civil Engineering Support.* It provides joint engineer planners with detailed, logistically focused planning and operational requirements for shaping the joint force battlespace from a facilities and infrastructure perspective. The current revision improves on the September 1995 version by presenting operational and strategic considerations for planning, coordinating, and executing civil engineering operations. As requested by the field, JP 4-04 also fully describes the military civil engineering capabilities within the Services, contract construction agents, and contractors.

U.S. Army Engineer School personnel actively participated in the revision of this publication. As lead agent, the Navy (Naval Facilities Engineer Command) is currently staffing JP 4-04 with the commanders in chief and Services. The first draft is available in the joint electronic library at *http://www.dtic.mil/doctrine/jel.*

JP 3-15

JP 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare,* outlines how mobility and countermobility operations can enhance the terrain and shape the battlespace to support the commander's operational and strategic objectives. In comparison to U.S. Army doctrine, the publication serves as the operational compilation of principles discussed in FM 90-13-1, *Combined Arms Breaching Operations,* FM 20-32, *Mine/Countermine Operations,* and FM 90-7, *Combined Arms Obstacle Integration.* Unlike these field manuals, however, JP 3-15 presents the land, air, and maritime components of mine/countermine warfare.

JP 3-15 completed the doctrine development cycle on 24 February 1999. It is available at *http://www.adtdl.army.mil* (Joint Publications).

Linking Joint and Army Doctrine

Unlike the joint doctrine library, the Army's numbering system for doctrinal publications follows no discernable set of rules. Some engineer manuals, such as the 5-71 series, align engineer doctrine with its associated maneuver doctrine, but in most cases the numerical designation gives no indication of its hierarchial position or subject.

In August 1997, TRADOC initiated a program to revise the Army doctrine hierarchy to link it by number and function to the joint publications system. The purpose of this initiative is to—

- Enable the Army to move in concert with an established, systematic joint doctrine system with the other Services.

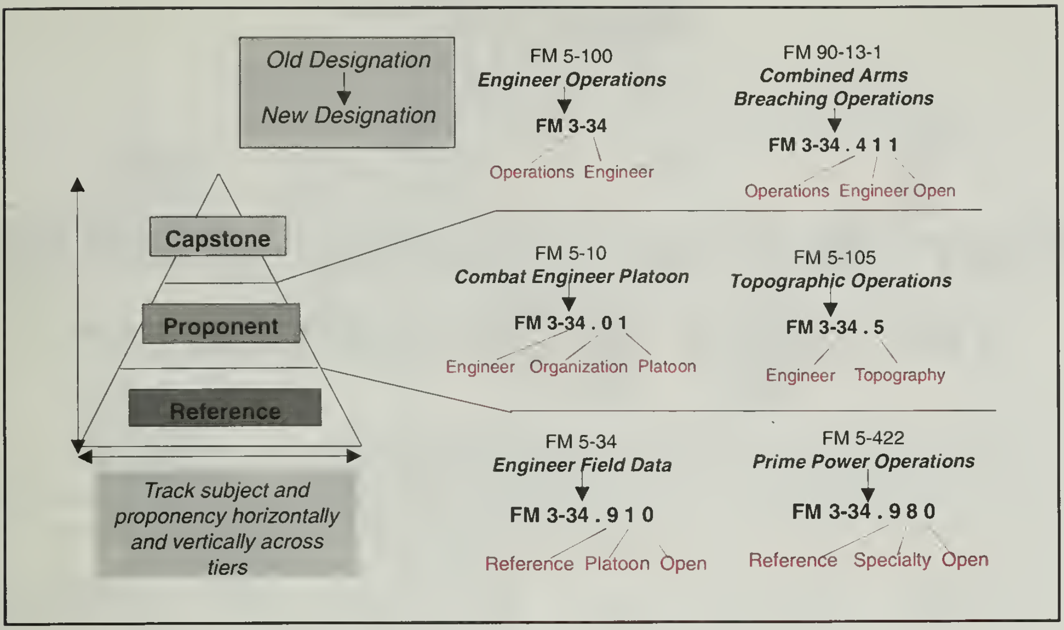


Figure 5. Linking joint and Army doctrine

- Groom young officers for the increasingly joint, interagency, and multinational nature of future military operations.
- Facilitate planning, preparation, and conduct of joint operations by Army headquarters.

The joint doctrine numbering system follows a fixed set of rules, as depicted in Figure 4, page 26. The first digit corresponds to the staff functional area for the content of the publication (1-Personnel, 2-Intelligence, 3-Operations, etc.). The second and third digits correspond to an existing joint publication or the Service proponent for the publication (20-Armor, 21-Infantry, 34-Engineer, etc). The fourth digit describes the content of the publication: organization, equipment, reference, and for engineer publications, the type of engineering covered (topographic, general, diving, etc.). Subsequent digits in the numbering system serve as further descriptors to the manual's content.

The end product of this hierarchial method is a three-tier system that allows field personnel to track proponency and functional areas horizontally and vertically across tiers (Figure 5). The upper tier delineates Army or capstone doctrine and aligns those manuals with their corresponding joint publications. The following examples show how current capstone Army field manuals will be renumbered:

- FM 100-5, *Operations,* will become FM 3-0, *Operations,* which aligns with JP 3-0, *Doctrine for Joint Operations.*
- FM 5-100 *Engineer Operations,* will become FM 3-34, *Engineer Operations,* which aligns with JP 3-34, *Engineer Doctrine for Joint Operations.*

The second tier consists of proponent and branch-specific doctrine and publications on tactics, techniques, and procedures. The lowest tier consists of reference-related doctrinal publications that contain tabular data, general reference, or common equipment. Examples of field manuals in each tier and their future designations are shown in Figure 5.

The revised doctrinal numbering system has been approved at all levels throughout the Army. Implementation of the system is expected to begin with the new version of FM 100-5 (FM 3-0), *Operations,* when it is published. Subsequent renumbering of existing field manuals will occur during the normal review or reprinting process.

Conclusion

U.S. Army Engineer School personnel continue to participate in the doctrine development process for joint publications. In an effort to improve field operations, considerable strides have been made over the past several months to ensure that lessons learned from recent operations have been captured in our joint engineer doctrinal publications.

For more information, call MAJ Spellmon at DSN 676-7537 or commercial (573) 563-4106.

Major Spellmon is chief of the Doctrine Development Division at the U.S. Army Engineer School. Previous assignments include observer/controller at the Combat Maneuver Training Center; company commander, 82nd Engineer Battalion; and platoon leader, 8th Engineer Battalion. MAJ Spellmon is a graduate of the U.S. Military Academy and the U.S. Army Command and General Staff College and holds a master's degree in civil engineering from the University of Illinois.

Military Support Detachment (RAID): The Tip of the Military Spear

By Colonel Kenneth Gonzales

A new unit is standing up at Fort Leonard Wood—the 7th Military Support Detachment (MSD) Rapid Assessment and Initial Detection (RAID). Like its nine counterparts—one in each Federal Emergency Management Agency (FEMA) region—it has a mandate. Authorized and funded in the FY99 defense bill, it must be manned, equipped, trained, certified, and validated fully mission capable no later than 5 January 2000. Ambitious as this may seem, its fielding is very much in progress.

Because the RAID detachments are so new and their concept-to-fielding process transcends standard procedures for introducing new force structure, they are already the subject of much misinformation. This article explains some of the background that led to their establishment, how the RAID detachments are manned and equipped, and what they are designed to do. I also briefly describe the 7th MSD (RAID) relationships with the Maneuver Support Center (MANSCEN) and the Total Army Center of Excellence for Homeland Defense initiatives at Fort Leonard Wood.

Background

Our nation's awareness of the threat from terrorist acts and incidents involving weapons of mass destruction (WMD) has been mounting throughout the 1990s. Events such as the bombings at the New York City World Trade Center, the Tokyo subway, and the Murrah Federal Building in Oklahoma City accelerated the need to take action. In June 1995, President Clinton issued Presidential Decision Directive 39. It provides guidance for distinguishing between "consequence management" and "crisis management" and establishes specific objectives and accountability for federal agencies. The directive's objectives include deterring, defeating, and responding to all terrorist attacks on our territory and managing the consequences of such attacks.

Nunn-Lugar-Domenici legislation contained in the FY97 defense bill directed the Secretary of Defense to more fully engage the military in measures to protect our nation from terrorist attacks involving WMD. Accordingly, the Department of Defense is providing for training, expert advice and assistance, loan of equipment, rapid response capability, and the use of the National Guard and other elements of the Reserve Components.

In May 1997, the National Security Council released *The National Security Strategy for a New Century.* Our nation's security planners recognized that "...because of our dominance in the conventional military arena, adversaries who challenge the United States are likely to do so using asymmetrical means such as weapons of mass destruction, information operations, or terrorism." A few months later, the Secretary of Defense released an updated *National Military Strategy* (October 1997). It provided additional insight into an acknowledged vulnerability: "...terrorism, the use or threatened use of WMD... have the potential to threaten the U.S. homeland and population directly and to deny us access to critical overseas infrastructure."

Other reports since then from the Defense Science Board, Foss-Downing Commission (CB 2010), and Quadrennial Defense Review also acknowledged the terrorist threat. Among the conclusions reached by these separate studies was one common recommendation: greater use of the National Guard and other elements of the Reserve Components.

In response to these findings and recommendations, the Department of Defense established a special committee to investigate how to better integrate National Guard/Reserve Component WMD capabilities to enhance military response to civil authorities. Designated the 'Tiger Team," its charter was straightforward: construct a complete model for integrating the Reserve Components into a consequence-management response for domestic terrorist incidents involving WMD.

Establishment

Among recommendations posed by the Tiger Team's early 1998 report was the establishment of a rapid assessment and initial detection capability in the National Guard. The original recommendation called for 54 teams (one for each state, territory, and Washington, D.C.).

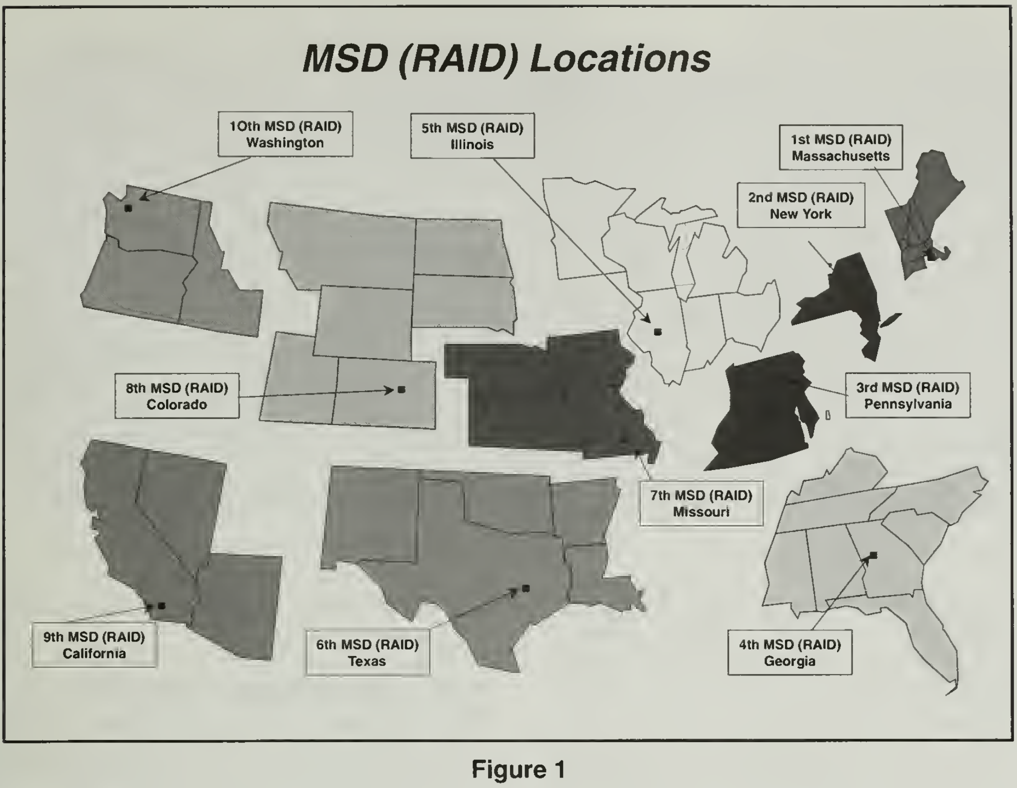


Figure 1

The manning document provided for 44 personnel: 22 full-time (Active Guard/Reserve) and 22 part-time (traditional or mobilization-day guardsmen). These teams were to be trained and equipped to standards compatible with the civilian "first responders" (fire, police, emergency medical, and hazardous materials) they were designed to support.

Despite time, budgetary, and legislative obstacles, the Tiger Team's recommendation became a reality when the 1999 defense bill was signed. Final legislation, however, reduced the number of National Guard teams from 54 to 10 (one for each of the 10 FEMA regions) and provided for only 22 full-time Active Guard/Reserve personnel (no traditional guardsmen). Figure 1 shows the 10 FEMA regions and the MSD (RAID) states.

Mission

The purpose of MSD (RAID) is multifaceted. From the time of notification, units are designed to deploy within 4 hours to the site of a suspected terrorist incident within the FEMA region they support. The RAID detachments operate in direct support of civilian first responders. The local agency head that has authority over the incident response is referred to as the incident commander. In terrorist incidents characterized by explosive devices, fires, hazardous materials, etc., the incident commander is normally the local civilian fire chief. The RAID detachments, in direct support of incident commanders, help first responders identify and assess the nature of an attack and determine the presence and type of nuclear, chemical, biological and/or radiological (NBCR) contamination. The detachments are trained and equipped to provide on-scene medical and technical advice to incident commanders and have the knowledge and capability to reach back for follow-on state, federal, and military assets. Figure 2 shows the MSD (RAID) mission statement.

The MSD (RAID) 22-man table of distribution and allowances provides for six subteams: command and control, operations, communications, administration/logistics,

MSD (RAID) Mission

The MSD (RAID) deploys to an incident site in support of the local incident commander to:

- **ASSESS a suspected nuclear, chemical, biological or radiological event.**
- **ADVISE civilian responders regarding appropriate actions.**
- **FACILITATE requests for assistance to expedite the arrival of additional state or federal assets to help save lives, prevent human suffering, and mitigate great property damage.**

Figure 2

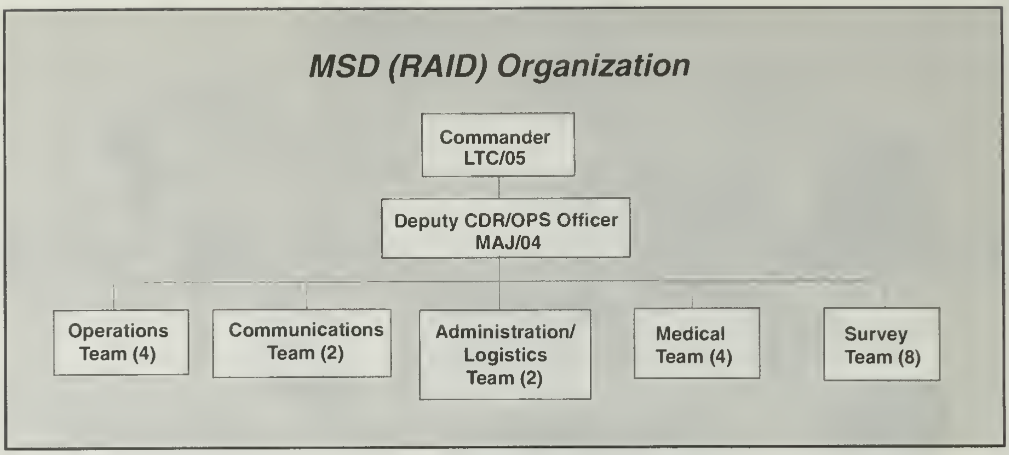


Figure 3

medical, and survey. Figure 3 depicts how the RAID detachments are structured. All positions may be filled by either Army or Air National Guard personnel.

Command and Control Team

The command and control team oversees the MSD (RAID), advises the incident commander on appropriate responses to WMD incidents, and facilitates follow-on support. The team also coordinates all public affairs issues for the MSD (RAID).

Operations Team

The operations team conducts planning, hazard modeling, and interagency coordination and schedules individual and collective training for MSD (RAID) personnel. The team helps plan and conduct interagency exercises, conducts force protection and liaison functions, and coordinates MSD (RAID) sustainment training.

Communications Team

The communications team supports the technical needs of the MSD (RAID). It provides day-to-day communications (internal and external voice and data networks) while the RAID detachment is at home station. Once mobilized, it supports team communications en route to an incident site. Upon arrival at the incident site, the communications team keeps the MSD (RAID) commander in touch with the incident commander and other reach-back support as needed.

Because of the civil-military implications of this team, MSD (RAID) communications equipment appears more civilian than military. Civilian fire, police, and emergency medical service departments frequently employ 800/900 MHz two-way radio communications systems. HF/UHF/VHF systems frequently are used to link military and federal agencies. Pagers, cellular telephones, and tactical satellite voice and data telecommunications systems supplement the radio-based systems that provide communications power to the MSD (RAID) commander and the supported incident commander.

Administration/Logistics Team

The administration/logistics team procures, stores, accounts for and maintains all MSD (RAID) equipment. It also provides traditional administrative and personnel functions common to all units. The challenges of its support are magnified by the unique requirements of the unit. The communications systems described above are representative of the unusual and nonstandard military character of the MSD (RAID). Transportation and protective gear are other examples of the unique nature of this unit. Its vehicles are nonstandard—General Services Administration vans and sport utility models. While all team members are issued personal protective equipment and carry M40 masks, the survey team is trained to operate in Level A suits (spacesuit-type outer garments with self-contained breathing apparatus).

Medical Team

The medical team advises the incident commander of health and medical implications for personnel in areas affected by a WMD incident. Team members are trained and resourced to coordinate with local, state, and federal health-care officials and agencies for follow-on support as needed. The medical team provides basic medical care for MSD (RAID) members and conducts physical assessments before and after survey team members enter potentially contaminated WMD incident sites.

Survey Team

The survey team conducts nuclear, biological, chemical and radiological (NBCR) surveys at a WMD incident site, as directed by the MSD (RAID) commander. Survey team members are at the heart of the MSD (RAID) weapons-of-mass-destruction incident response. They are trained and equipped to enter the "hot zone," obtain samples of possible NBCR contaminants, and monitor local contamination levels.

They are equipped with the latest technology for detecting and assessing possible contaminants. In addition to familiar military detection and monitoring equipment, the survey team brings sophisticated diagnostic tools like the gas chromatograph and mass spectrometer to the incident commander. Having these devices available is critical to the unique mission of the MSD (RAID) and its support to civilian authorities.

Command and Control

Operationally, the MSD (RAID) falls under the command and control of the adjutant general of the state to which it is assigned. As a Title 32 National Guard asset, its deployment to support civilian authorities during a WMD incident is similar to other state disaster deployments in which the National Guard has been involved for many years.

Recognition of the long-standing relationship between the National Guard and civilian authorities was an influencing factor in deciding where to place the MSD (RAID) capability. Deployment of the detachments to other states is coordinated through FEMA. In those circumstances, the MSD (RAID) falls under the command and control of the receiving adjutant general, while remaining in direct support of the local incident commander. Many other doctrinal, training, equipment, evaluation, and deployment considerations for MSD (RAID) are still being developed.

Stationing the 7th MSD (RAID) at Fort Leonard Wood offers it some advantages that the other detachments won't enjoy. During FY99, the Army's Chemical and Military Police Schools will join the engineers as co-tenants of Fort Leonard Wood. While the dynamics of this union may take years to fully realize, the 7th MSD (RAID) will reap some immediate benefits. Subject matter expertise available in the three schools will enable the 7th MSD (RAID) to lead in doctrine, training, leader development, organization, materiel, and soldiers (DTLOMS) issues affecting its mission.

The advantage works both ways. Discussions with senior members of the school staffs reveal that they already see benefits for their students, battle lab experiments, facilities employment, leader development, and training by having a RAID detachment in their own backyard. Designated the Maneuver Support Center and established to leverage the synergistic impact of all three schools, Fort Leonard Wood is a showcase for TRADOC's reorganization initiative around battlefield functions. (See *Engineer,* April 1998). Through its stationing at the MANSCEN, the 7th MSD (RAID) benefits from this consolidation. No other installation brings together the subject matter experts, training opportunities, and battle lab facilities as well as Fort Leonard Wood.

Threat Response

In homeland defense and Department of Defense initiatives to provide for the defense of our nation, the MSD (RAID) is the tip of the military spear in responding to incidents involving WMD. In fact, while our leaders determine how to bring all strategic assets into coordinated alignment (information operations, national missile defense, special operations forces, etc.), the MSD (RAID) stands out as the military's newest and most visible capability for responding to the threat of domestic terrorism.

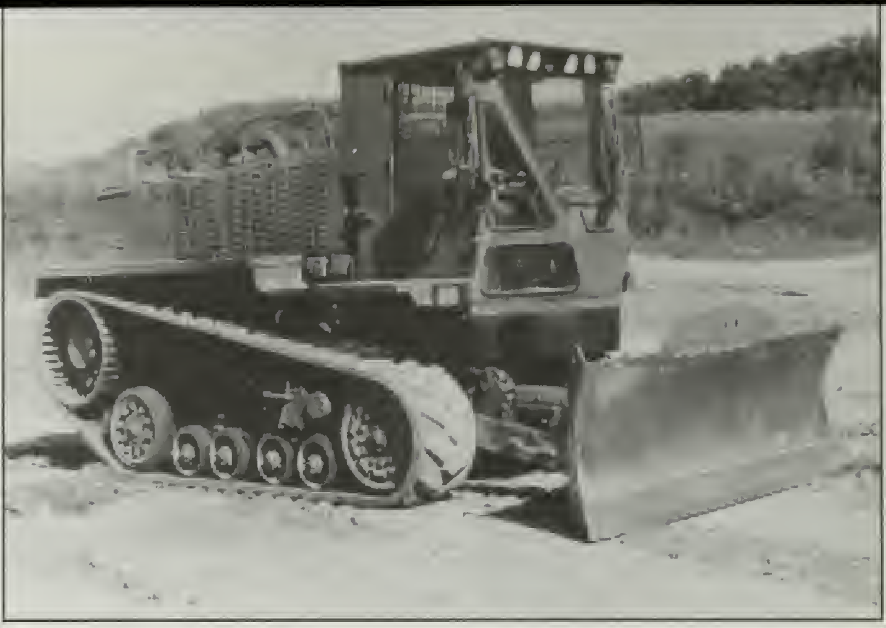
The designation of MANSCEN as the Total Army Center of Excellence for Homeland Defense training, experimentation, and force integration is a given. At MANSCEN, troops will train to detect, defend against, and decontaminate NBCR weapons. Soldiers will manage the treatment and evacuation of casualties and assist with the quarantine of affected areas and personnel. Proponent responsibilities of the Chemical, Military Police and Engineer Schools (the MANSCEN) are to respond to NBCR contamination, counter the threat of terrorism, protect the force, secure projection platforms, and ensure continuity of critical infrastructure. The physical and intellectual capital invested in Fort Leonard Wood today will contribute to the Total Army's success in executing homeland defense missions. Stationing the 7th MSD (RAID) at Fort Leonard Wood is part of that investment.

Conclusion

The requirement for a rapid assessment and initial detection capability was documented by numerous studies and technical working groups. Hence, the establishment of the Military Support Detachment (RAID). Stationed in the 10 FEMA regions of the United States, these National Guard detachments will be designed, trained, and equipped to detect and assess NBCR contamination resulting from terrorist acts involving weapons of mass destruction. The MSD (RAID) will augment civilian authorities with technical capabilities beyond those normally found among first responders.

If called on to respond to a WMD incident, an MSD (RAID) deploys to support civilian authorities as the initial military response element on the scene. For the Department of Defense, the National Guard's MSD (RAID) capability is the tip of the military spear. For Fort Leonard Wood, the Maneuver Support Center, and the Total Army Center of Excellence for Homeland Defense, the 7th MSD (RAID) is a unique tenant activity and a viable partner for the future.

Colonel Gonzales is director of plans, operations, and training for the Missouri National Guard. He commanded the 175th Military Police Battalion and has served at the National Guard Bureau in Washington, D.C. COL Gonzales holds a master's degree in education and is a graduate of the Army War College.



The First DEUCEs are "On the Ground"

By Jeffrey Klein

On 29 January 1999, the U.S. Army Engineer School received the first two production deployable universal combat earthmovers (DEUCEs). This highly anticipated earthmover, which will soon be in the Army construction equipment inventory, will provide light infantry and airborne combat engineers with an unprecedented self-deploy capability. The Engineer School's two DEUCEs will supplement the school's training mission by providing advanced technologies and will help define future mission doctrine.

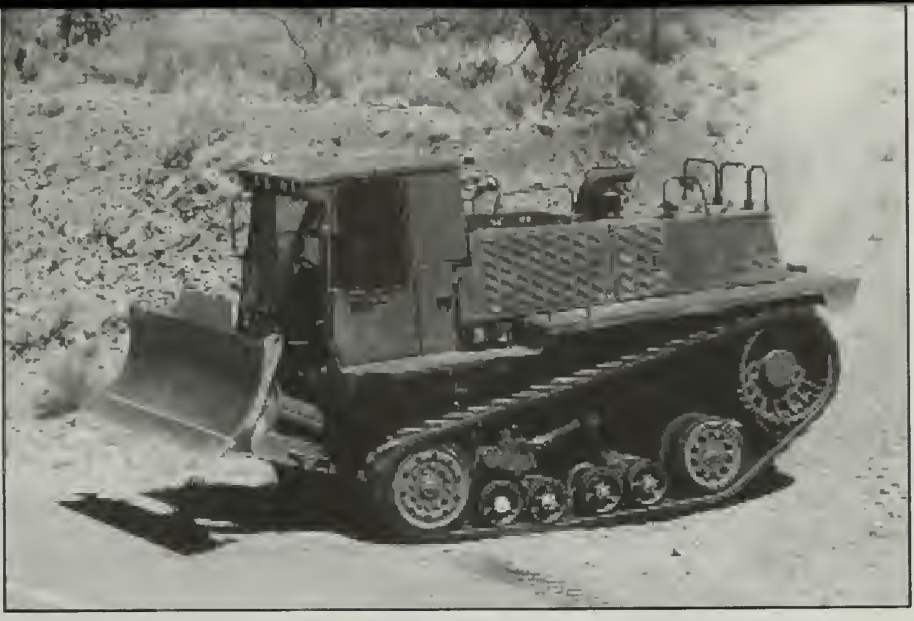
In addition to receiving the equipment, Engineer School instructors, maintainers, and operators received instructor and key personnel training. These critical personnel will train future Army soldiers in the correct operation and maintenance of the tractors. They are at the top of a teaching pyramid that will rapidly multiply the number of properly trained engineer soldiers.

In the earthmoving mode, the DUECE's blade can be tilted in six different positions with a joystick.

Description

The DEUCE is the result of an ongoing partnership between the Tank-Automotive and Armaments Command (TACOM), in Warren, Michigan, and the contractor, Caterpillar Inc., Defense and Federal Products Department. A contract awarded to Caterpillar in 1995 is managed by TACOM's project manager for Tank-Automotive Weapon Systems (PM TAWS) and the product manager for Construction Equipment/Material Handling Equipment (PM CE/MHE). Representatives from both TACOM and Caterpillar attended the DEUCE handoff at Fort Leonard Wood.

The DEUCE's engine, transmission, and suspension configuration combine to allow it to travel in the self-deploy mode at speeds up to 30 mph. It has an automatic 6-speed transmission and a fully suspended undercarriage. The rubber track is lighter and less damaging to road surfaces than a traditional



In the self-deply mode, the DUECE can travel up to 30 mph on asphalt roads without causing damage.

steel-track design. This configuration allows for a safe and comfortable ride and eliminates the need for additional hauling assets between job sites.

The flip of a switch engages the earthmoving mode. The DEUCE operates with a standard power-shift transmission, a locked-out suspension for a rigid dozing platform, and a dozing capability comparable to the D5 dozer currently authorized to some 18th Airborne engineer units. The DEUCE is designed for driving on and off C-130, C-141, C-5, and C-17 aircraft and is undergoing certification testing for C-130 airdrops.

The DEUCE will be used primarily to prepare airstrips, roads, and protective positions. To increase its effectiveness, the operator may communicate from within the DEUCE with the single-channel, ground-to-air radio system (SINCGARS) and precise light-weight GPS (global positioning system) receivers (PLGR). The DEUCE uses a six-way hydraulic power-angle-tilt blade and a rear-mounted 22,000-pound hydraulic winch. The Caterpillar 3126 Hydraulic Electronic Unit Injector engine has dual power settings, which produce 185 hp in the earthmoving mode and 265 hp in the self-deploy mode. The DEUCE is equipped with an enclosed, climate-controlled cab that allows optimal performance from a less-fatigued operator. The engine, as well as 75 percent of about 3,000 serviceable DEUCE components, has proven its durability through Caterpillar's extensive commercial experience.

Testing

Initial testing indicated that the undercarriage design, although adequate for commercial applications, was not sufficient for rigorous military operations. After consulting with all appropriate commands, including U.S. Army Forces Command and the Engineer School, the PM CE/MHE initiated a nine-month testing and redesign period with the goal of improving the future readiness of the machines. The result is a much improved undercarriage design.

According to the assistant product manager for the DEUCE, the rubber track technology has been proven over the years on Caterpillar's Challenger series of agricultural tractor. The entire undercarriage, including the steel-reinforced solid rubber track, has undergone extensive testing across the country. Testing conditions included knee-deep mud and clay at Aberdeen Proving Grounds; frozen soil (sand, gravel, and clay) at Caterpillar's Minneapolis facility; desert rock and sand at Caterpillar's Arizona Proving Grounds; and a Midwest mix of clay, sand, gravel, and mud at Caterpillar's proving grounds in Peoria, Illinois. All of this data was incorporated in the final undercarriage design that soldiers will receive. Sharp volcanic rock in Hawaii and Fort Lewis, Washington, will undoubtedly increase the grouser wear rate, similar to the experiences of rubber-tired vehicles, but the transportability advantages of this type of track are necessary to meet the quick-strike capabilities of light and airborne engineers.

Fielding

Before delivering these machines, unit personnel will receive three days of operator training and five days of maintenance training. The advanced design of the operator's compartment, along with the ergonomically designed operator controls, allow for these minimal operator-training requirements. For example, the automotive-type steering wheel, accelerator pedal, and brake pedal typically are not associated with tracked construction equipment.

The 10th Mountain Division (Light) at Fort Drum, New York, is scheduled to receive the first DEUCE in May 1999. The 82nd Airborne Division at Fort Bragg, North Carolina, will be outfitted with the DEUCE in June, followed by the 20th Engineer Brigade at Fort Bragg. Fielding the acquisition objective of 160 DEUCEs will continue through 2002.

The coming months will be busy as product managers from both TACOM and Caterpillar's Defense and Federal Products Department prepare for the initial fieldings. At that time, TACOM and all of the DEUCE team members will have achieved their goal of fielding a capable, reliable, and supportable piece of equipment to the soldiers of the 21st century.

Mr. Klein is the DEUCE project engineer and works on the Construction Equipment Team at TARDEC. He holds a bachelor's degree in mechanical engineering from Virginia Tech and a master's degree in mechanical engineering from Catholic University, Washington, D.C.

Army Experimentation Campaign Plan:

Total Army and Joint Teamwork Toward a Full-Spectrum Land Force

By Vern Lowrey

General Reimer, Chief of Staff, United States Army, recently approved a new path to the future that is described as the *Army Experimentation Campaign Plan* (AECP). The AECP is a result of the Army's successful experimentation since 1993 with new ideas, technologies, equipment, and organizations as part of the Force XXI process. Results from experimentation with mechanized forces and digital technologies at Fort Hood, Texas, and the National Training Center (NTC), Fort Irwin, California, led General Reimer and Army leaders to expand experimentation efforts into other areas. These areas include light contingency forces, Strike Forces, and future Army After Next (AAN) forces. The AAN forces include Battle Forces, campaign forces, homeland defense forces, and special operations forces (SOF).

The AECP path to the future shown in Figure 1 takes the Army from the current Army of Excellence (AOE) organization through a spiral development process. Beginning with research and study, science and technology, and experimentation, the process spirals through the newly designed Army XXI Division toward AAN and its various franchise study groups. Fort Leonard Wood will lead Army homeland defense doctrine, training, leader development, organization, materiel, and soldier (DTLOMS) developmental efforts (See article on page 38).

The three AECP experimentation axes shown in Figure 2, page 35, will guide the Army over the next 10-25 years. Mechanized and light force axes will lead to fully digitized mechanized and light corps by 2010. Current Strike Force experimentation efforts will create a deployable headquarters that can quickly assimilate Army warfighting capabilities to meet strategic and operational requirements in a theater of operations. The Army is teaming with its joint partners in the U.S. Navy, Marine Corps, and Air Force through a series of joint experiments over the next several years to develop mutually supporting technologies and organizations. Army engineers will continue to be key players in all AECP experimentation efforts. The following potential issues and initiatives will be addressed in future AECP experimentation efforts.

Mechanized Contingency Forces. An article beginning on page 40 describes lessons learned from early experimentation with mechanized forces. Experimentation continues with the 4th Infantry Division at Fort Hood, Texas

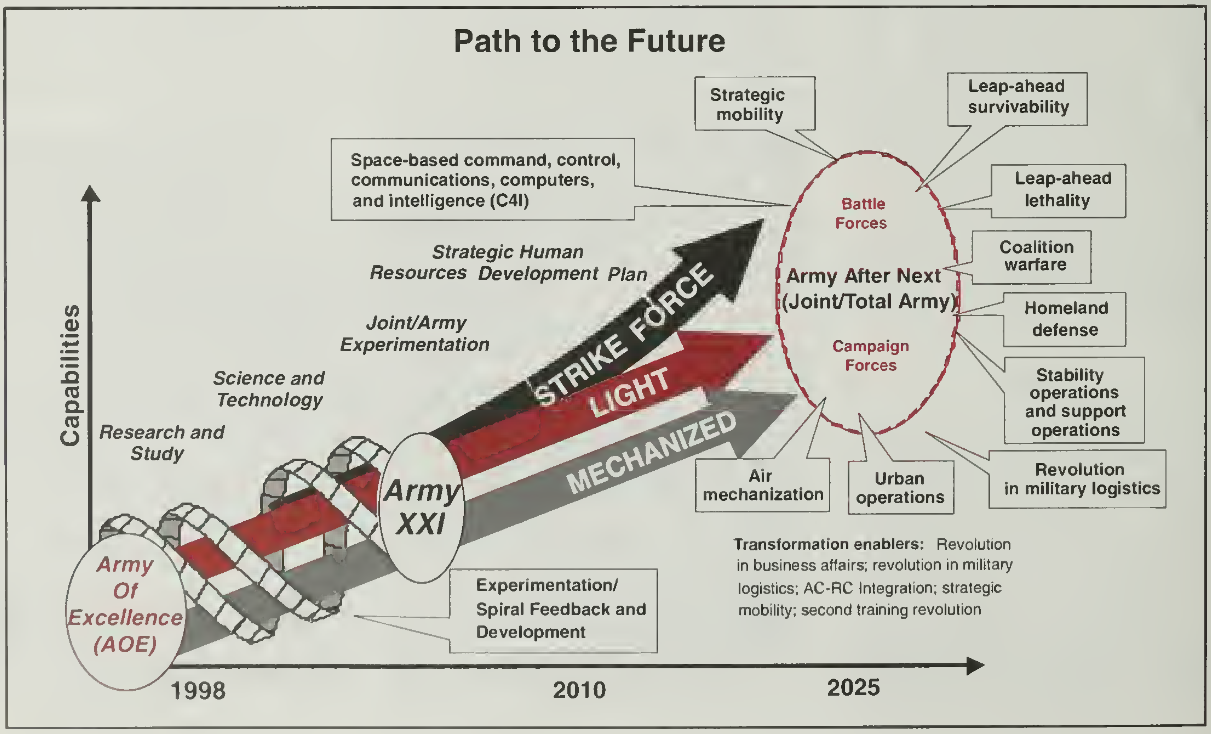

Path to the Future
Strategic mobility
Leap-ahead survivability
Space-based command, control, communications, computers, and intelligence (C4I)
Leap-ahead lethality
Battle Forces
Coalition warfare
Army After Next (Joint/Total Army)
Homeland defense
Campaign Forces
Stability operations and support operations
Revolution in military logistics
Air mechanization
Urban operations
Strategic Human Resources Development Plan
Joint/Army Experimentation
Science and Technology
Research and Study
STRIKE FORCE
LIGHT
MECHANIZED
Army XXI
Army Of Excellence (AOE)
Experimentation/ Spiral Feedback and Development
Capabilities
1998
2010
2025
Transformation enablers: Revolution in business affairs; revolution in military logistics; AC-RC Integration; strategic mobility; second training revolution

Figure 1

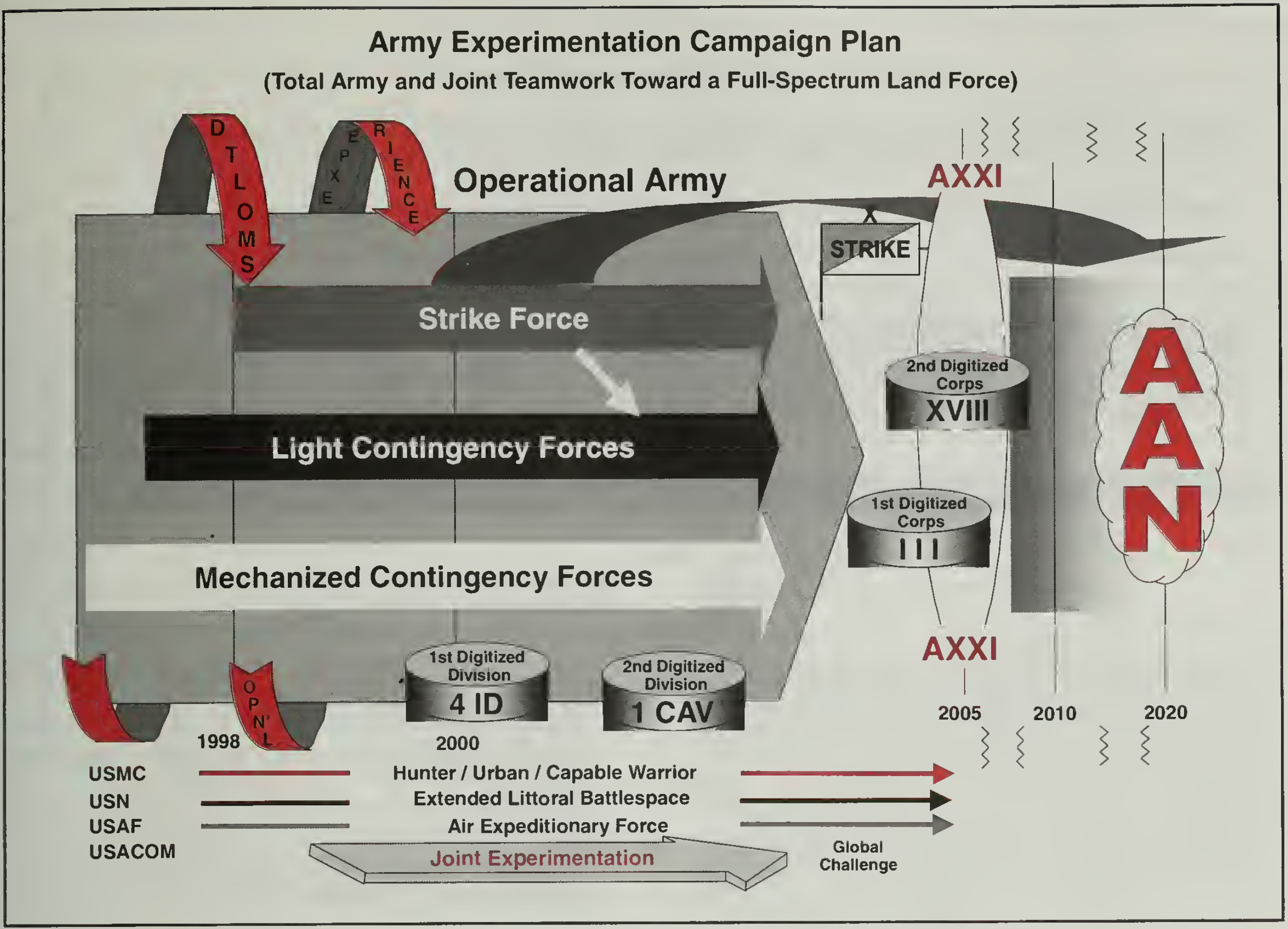


Figure 2

(Figure 3, page 36). The Army will validate the first digital division design in FY01 during division capstone exercises (DCX) at both Fort Hood and NTC. Following the DCX, the 1st Cavalry Division at Fort Hood will start digitizing its command and control capability. Ongoing hardware integration and software upgrades within the Army Battle Command System, including the Force XXI Battle Command Brigade and Below (FBCB2) platform computer system, will continue through the DCX. Training and Doctrine Command (TRADOC) is developing a Corps XXI design that will focus on the new battlefield framework of shaping, decisive, and sustainment operations. This design will replace the current Air–Land Battle framework of deep, close, and rear operations. The new Corps XXI design will be validated during a Corps advanced warfighting experiment (AWE) that will examine both heavy and light corps operations. The following are some of the engineer issues to be addressed in the mechanized contingency force experimentation axis:

- Army XXI division engineer command and control structure.
- Corps XXI engineer command and control structure.
- Joint combat engineer command and control tools.
- Army XXI division consolidated combat service support structure for engineers.
- Digital terrain data acquisition, management, dissemination, and storage.
- Engineer Bradley fighting vehicle.
- Route minefield clearance.
- Maneuver control system-engineer (MCS-E) software.

Light Contingency Forces. The Army has conducted very few experiments with light contingency forces over the past several years. That situation is changing because we will be involved with the Joint Contingency Force (JCF) AWE, which will be conducted at the Joint Readiness Training Center, Fort Polk, Louisiana, in the fall of 2000. As shown in Figure 4, page 36, the JCF AWE will showcase new warfighting technologies and digital command and control linkages, which were developed during the Rapid Force Projection Initiative's (RFPI) advanced concepts technology demonstration (ACTD) and the ongoing Military Operations in Urbanized Terrain (MOUT) ACTD at Fort Benning, Georgia. The 10th Mountain Division from Fort Drum, New York, will be the JCF AWE experimental force. The XVIII Airborne Corps headquarters, Fort Bragg, North Carolina, will serve as the joint task force headquarters for the AWE. The United States Atlantic Command (USACOM) will serve as the overall joint experimentation headquarters for the AWE. The Marine Corps will participate through ongoing Urban Warrior experimentation that will continue through the JCF

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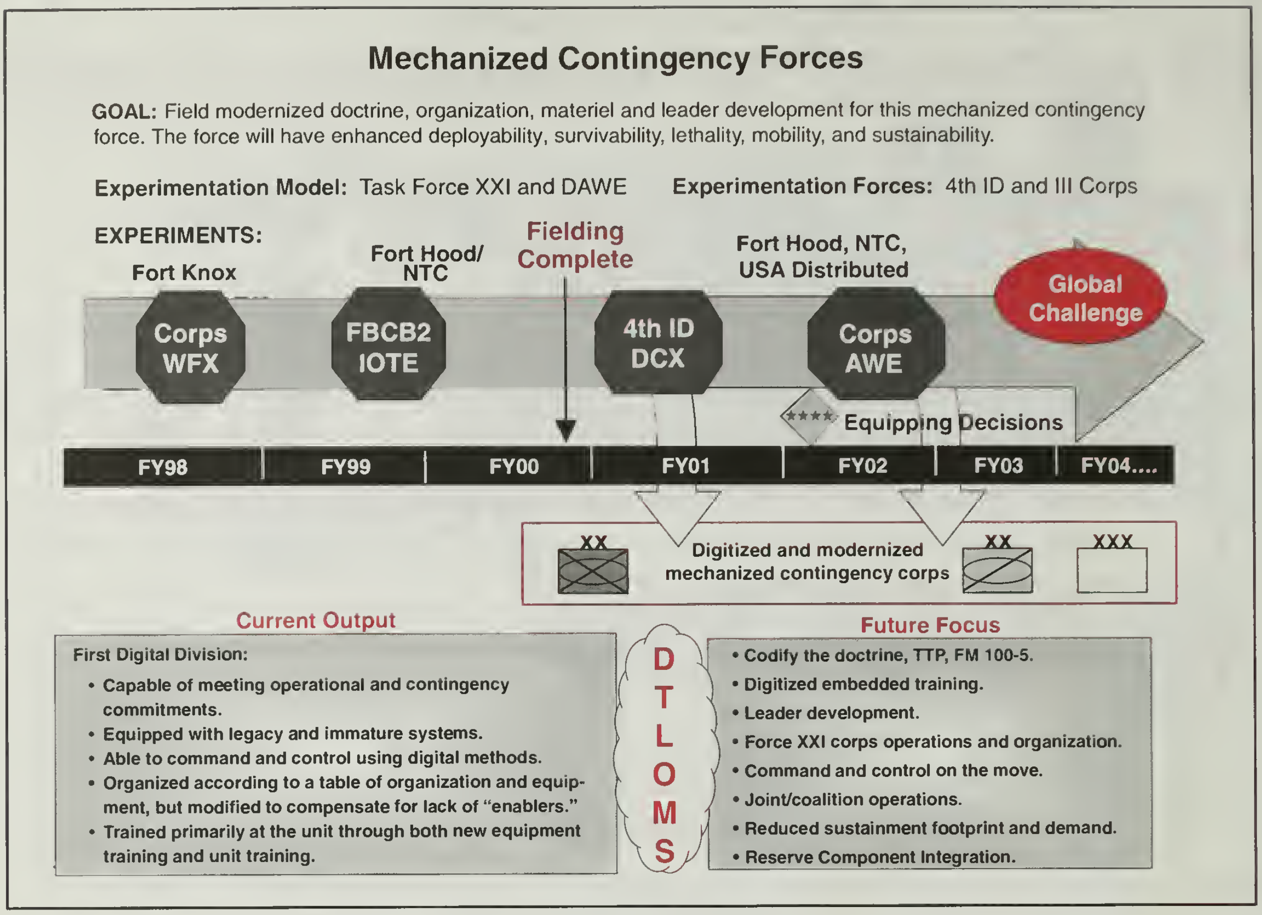


Mechanized Contingency Forces

GOAL: Field modernized doctrine, organization, materiel and leader development for this mechanized contingency force. The force will have enhanced deployability, survivability, lethality, mobility, and sustainability.

Experimentation Model: Task Force XXI and DAWE **Experimentation Forces:** 4th ID and III Corps

EXPERIMENTS:

Current Output

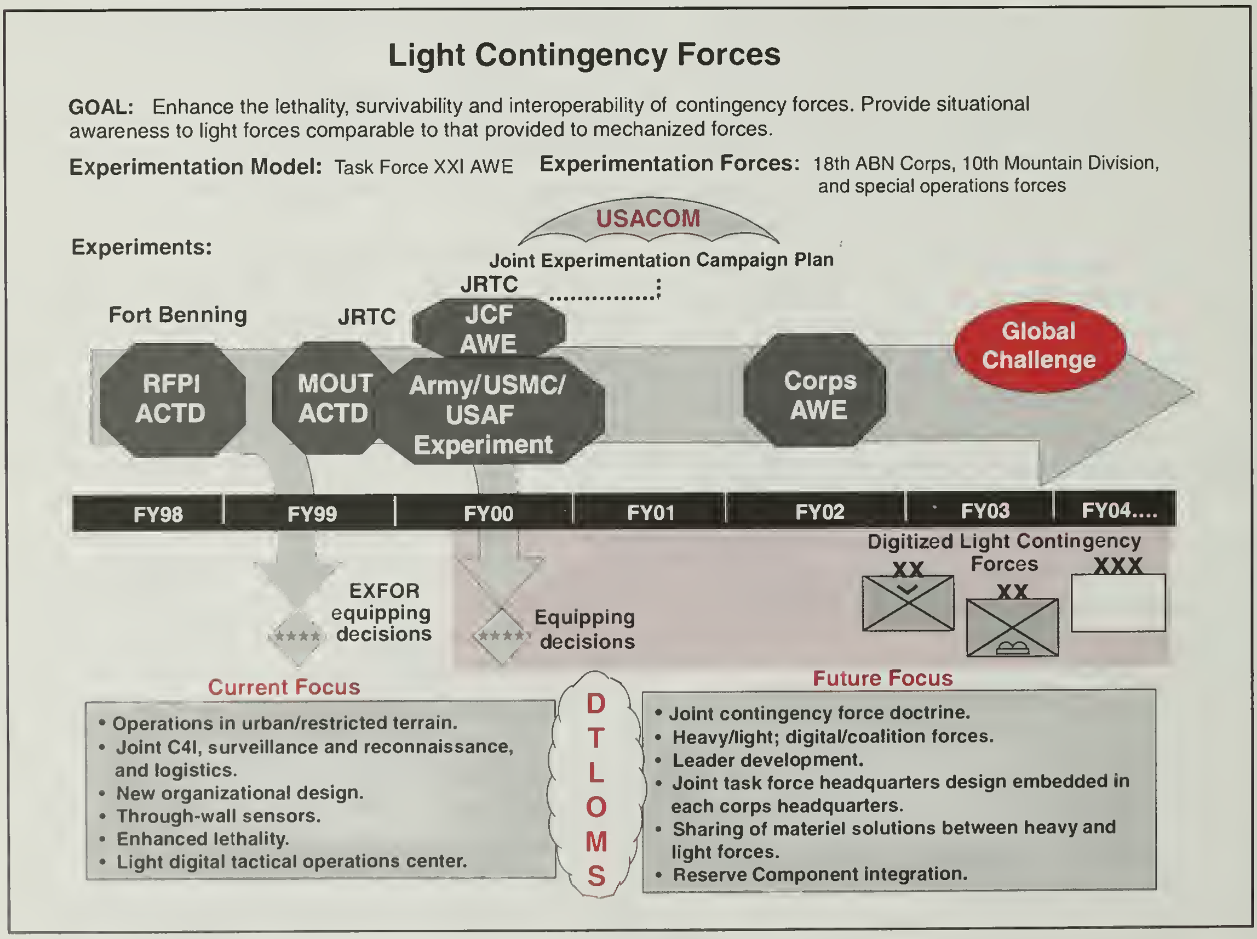
First Digital Division:

- Capable of meeting operational and contingency commitments.
- Equipped with legacy and immature systems.
- Able to command and control using digital methods.
- Organized according to a table of organization and equipment, but modified to compensate for lack of "enablers."
- Trained primarily at the unit through both new equipment training and unit training.

Future Focus

- Codify the doctrine, TTP, FM 100-5.
- Digitized embedded training.
- Leader development.
- Force XXI corps operations and organization.
- Command and control on the move.
- Joint/coalition operations.
- Reduced sustainment footprint and demand.
- Reserve Component Integration.

Figure 3



Light Contingency Forces

GOAL: Enhance the lethality, survivability and interoperability of contingency forces. Provide situational awareness to light forces comparable to that provided to mechanized forces.

Experimentation Model: Task Force XXI AWE **Experimentation Forces:** 18th ABN Corps, 10th Mountain Division, and special operations forces

Experiments:

Current Focus

- Operations in urban/restricted terrain.
- Joint C4I, surveillance and reconnaissance, and logistics.
- New organizational design.
- Through-wall sensors.
- Enhanced lethality.
- Light digital tactical operations center.

Future Focus

- Joint contingency force doctrine.
- Heavy/light; digital/coalition forces.
- Leader development.
- Joint task force headquarters design embedded in each corps headquarters.
- Sharing of materiel solutions between heavy and light forces.
- Reserve Component integration.

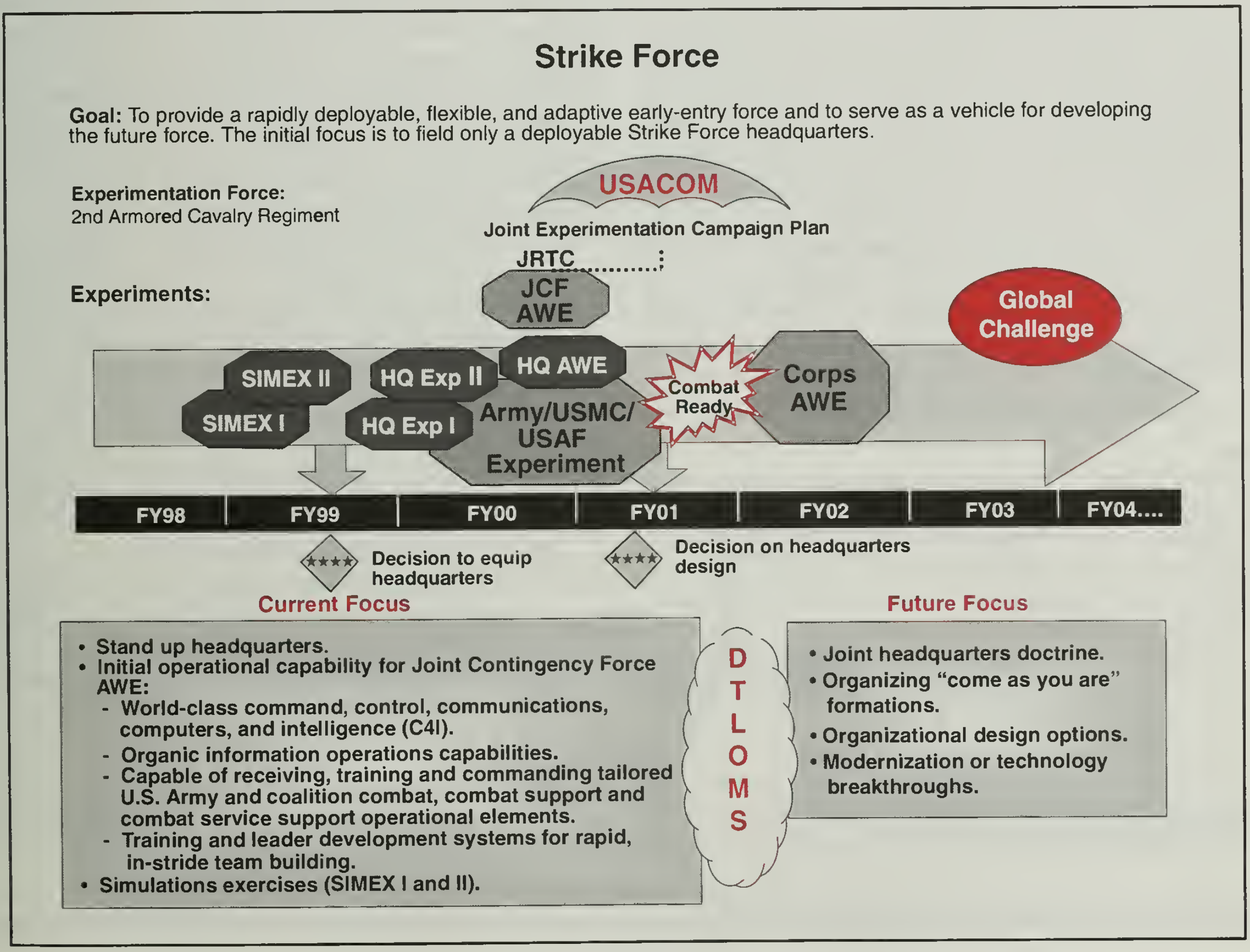
Figure 4

AWE. The Air Force also will participate as part of their Air Expeditionary Force experimentation process. A newly formed Strike Force headquarters will be evaluated during the JCF AWE. Results from the JCF AWE will be used to assess needed changes in light contingency forces and to identify issues for the follow-on Corps AWE. The following are some of the Army engineer issues to be addressed in the experimentation axis for light contingency forces:

- Rapid airfield construction.
- Digital terrain data acquisition, management, dissemination, and storage, especially in urban environments.
- Urban obstacle and rubble removal.
- Subterranean robotic reconnaissance.
- Advanced technologies for the demolition of buildings and walls.
- Digital command and control of engineers.
- Tactics, techniques, and procedures for the acquisition and operation of contingency engineer equipment.

Strike Forces. Strike Forces are part of the AECP to prepare combat and combat support organizations for future multifunctional operations. They will be part of a rapidly deployable, flexible, and adaptive early-entry force (Figure 5). The evolving Strike Force structure is intended to complement current light and heavy force capabilities. Strike Forces will serve as a bridge between the physical agility of Army XXI and the mental agility inherent in the Army After Next. Initial experimentation efforts will focus on the design and operations of the Strike Force headquarters being developed at Fort Polk, Louisiana. The following are some of the engineer issues to be addressed as part of Strike Force experimentation efforts:

- Engineer command and control requirements associated with the combat support node of the Strike Force headquarters.
- Digital terrain data acquisition, management, dissemination, and storage for Strike Forces.
- Requirements for a high-speed engineer vehicle as a possible complement or replacement for the small emplacement excavator (SEE).
- Engineer robotic applications.
- Capability of the deployable universal combat earthmover (DEUCE) to support more than light forces (see article, page 32).
- Lightweight bridging.



Goal: To provide a rapidly deployable, flexible, and adaptive early-entry force and to serve as a vehicle for developing the future force. The initial focus is to field only a deployable Strike Force headquarters.

Experimentation Force:
2nd Armored Cavalry Regiment

Experiments:

- Stand up headquarters.
- Initial operational capability for Joint Contingency Force AWE:
  - World-class command, control, communications, computers, and intelligence (C4I).
  - Organic information operations capabilities.
  - Capable of receiving, training and commanding tailored U.S. Army and coalition combat, combat support and combat service support operational elements.
  - Training and leader development systems for rapid, in-stride team building.
- Simulations exercises (SIMEX I and II).

- Joint headquarters doctrine.
- Organizing "come as you are" formations.
- Organizational design options.
- Modernization or technology breakthroughs.

Figure 5

Homeland Defense. Army leaders are defining this new mission area. Homeland defense encompasses many areas, including disaster relief, protecting the nation's infrastructure against weapons of mass destruction and terrorism, and vulnerability assessment tools. Fort Leonard Wood will become the Army's Center of Excellence for Homeland Defense on 1 October 1999, when the Maneuver Support Center officially stands up. The Maneuver Support Battle Lab has several ongoing engineer-related experiments that may become part of the homeland defense mission:

- Mine detection using chemical signature technologies.
- Evaluation of joint vulnerability assessment tools.
- Evaluation of an antiterrorism planning tool for blast effects.
- Force protection of logistics bases.

The Maneuver Support Battle Lab is charged with integrating all engineer experimentation activities associated with AECP. We continually seek new thoughts and ideas from field personnel related to AECP and homeland defense missions. For additional information or to pass on ideas, please call Colonel Greg Bean or Vern Lowrey at DSN 676-4082 or commercial (573) 563-4082. Our fax number is (573) 563-4083. *E-mail addresses are beang@wood.army.mil or lowreyv@wood.army.mil.*

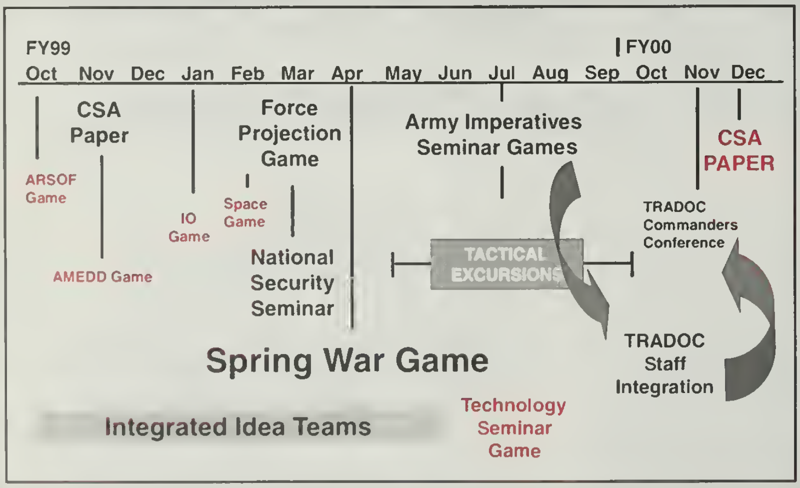
Mr. Lowrey is the technical director of the Maneuver Support Battle Lab at Fort Leonard Wood.

Engineer Contributions to Army After Next

By Lieutenant Colonel James Vosler

Knowledge, speed, and power are broad capabilities that will form the foundation of the Army After Next (AAN) in 2025. The Chief of Staff, United States Army, established the AAN project in February 1996 "...to assist our leadership in developing a vision of future Army requirements." The project's mission is to conduct broad studies of warfare out to the year 2025. These studies will frame issues vital to the development of the U.S. Army after 2010 and identify alternatives for senior Army leaders to integrate into TRADOC's combat development programs (see figure).

U.S. Army Engineer School personnel are actively engaged in the AAN project and participate in TRADOC-sponsored war games, technology seminars, and integrated idea teams that occur throughout the year. This year's AAN project will culminate with TRADOC's third annual report to the Chief of Staff of the Army in December 1999.



The AAN project's main effort each year concentrates on a spring war game at Carlisle Barracks, Pennsylvania. The game this year will examine asymmetric threats by opposing forces, which include weapons of mass destruction, information warfare, and operations within complex and urban terrain. Other war games planned for this year will examine implications resulting from the spring war game across the Army DTLOMS (doctrine, training, leader development, organization, materiel, and soldiers) imperatives. During the last week in April, the Engineer School will provide personnel to support both the blue and red commanders in chief at Carlisle Barracks to specifically address engineer issues.

Integrated idea teams bring together technical and military art experts to examine, refine, and provide insight into AAN FY99 concepts, capabilities, notional systems, and enabling technologies. This year Engineer School personnel participated in urban, hybrid, and C4I (command, control, communications, computers, and intelligence) integrated idea teams. Engineers are making significant contributions regarding the development of future force mixes and materiel requirements by participating in these events.

Although the year 2025 is far beyond most of our horizons, the Engineer School's participation in the AAN project will ensure that engineers remain relevant into the next century. Our efforts today will play a large role in shaping the Army of tomorrow.

Lieutenant Colonel Vosler is the strategic planner for the U.S. Army Engineer School and Fort Leonard Wood.

Book Review

The Bear Went Over the Mountain: Soviet Combat Tactics in Afghanistan, by Lester W. Grau, Frank Cass Publishers (Portland, Oregon), 1998, 220 pages. The ISBN is 0-7146-4857-4 for a hard-back copy and 0-7146-4413-7 for a paper-back copy.

Lester W. Grau's *The Bear Went Over the Mountain* provides an outstanding look at and commentary on Soviet tactics against the mujahideen fighters from 1979 to 1989. The author uses a series of vignettes that were originally published by the Soviet's Frunze Combined Arms Staff College. The intent was to pass on both positive and negative lessons learned from that conflict to Soviet forces. Given the college's original effort and Grau's translation, editing, commentary, and incisive conclusion, this unique work enlightens Western readers about the Afghan war. Grau's work is a tool that allows leaders to learn from the Soviets' efforts and possibly use this hard-won knowledge to keep their soldiers alive on future battlefields.

The introduction sets an attention-getting stage for the vignettes. A Soviet airborne division began to land in Kabul on December 24, 1979. By December 27, airborne and Spetsnaz forces had overthrown the Afghan government and killed the president while heavy divisions executed a cross-border invasion. A pro-Soviet president was installed on December 28. The last Soviet combat units withdrew from the country on February 15, 1989. In the intervening decade, 620,000 Soviets served in Afghanistan; 13,833 of them were killed and another 469,685 were sick or wounded. The Soviets left 118 jets, 333 helicopters, 147 tanks, 1,314 armored personnel carriers, 433 artillery pieces and mortars, 1,138 radio sets and command vehicles, 510 engineer vehicles and 11,369 trucks destroyed across Afghanistan's mountain-desert terrain.

After setting the stage, the author presents 47 vignettes that were written by junior officers based on their firsthand combat experiences against the mujahideen. The vignettes typically have four parts: the plan, a brief summary of mission preparation, the outcome, and both Frunze and Grau commentaries. A map showing key terrain features and Russian graphic-control measures accompanics each vignette. The author uses Russian map symbols because they clearly illustrate time-phased execution of the action. While the officers often developed the maps from memory and some have errors in location and terrain, the maps add significantly to the readers' understanding of the plan and its execution. Each vignette is an outstanding after-action review complete with graphics and commentary that capture key lessons learned.

Many of the vignettes discuss Soviet and mujahideen engineer operations. Mobility operations focus on route clearance, obstacle reduction, and creating "mouse-hole" entrances to buildings. While none of the vignettes discuss combined arms breaching in detail, breaching operations were part of several missions. The purpose of many missions was to find supply and arms caches and to destroy them using explosives. Soviet static positions and security outposts typically featured extensive protective obstacle systems. Both sides used mines and other obstacles to support ambushes. They blocked avenues of approach, fixed the enemy in the kill zone, and disrupted counterattacks against the ambushing unit's flanks. The mujahideen apparently were very adept at war-gaming likely reactions of Soviet vehicle drivers during ambushes and then mining those locations. The Soviets used BM-22-delivered scatterable mines as situational obstacles to disrupt withdrawing enemy forces. The combined effect of mujahideen mines on armor avenues of approach and the restricted terrain contributed to the ineffectiveness of Soviet tanks in the Soviet-Afghan war. Road mining by the mujahideen disrupted the movement of Soviet units and supplies. Although not specifically discussed, Soviet engineers apparently provided extensive survivability support to their base camps and sometimes dug in combat vehicles that occupied static blocking positions.

Lessons learned range from the basics of light and litter discipline to the correct use of indirect fires and the synchronization of mounted and dismounted elements. The value the noncommissioned officer corps provides to the U.S. Army is evident in almost every mission. In addition to the lessons in commentaries at the end of each vignette, Grau's concluding chapter addresses tactics, equipment, force structure, morale, and the effects of Soviet operations on the Afghan population. Interestingly, he states that engineers were always in demand. The book brings home the following key points concerning engineer operations:

- Effective terrain analysis is imperative.
- Obstacles must be integrated with fires to achieve their intended effect.
- Event triggers and an appropriate observation plan are essential to effectively employ situational obstacles.
- Engineers with mobility assets must be located near the front of every combat formation.

The Bear Went Over the Mountain is a valuable learning tool, especially for leaders at the battalion level and below. The vignettes are ideally suited to support a series of leader-development classes. The lessons learned are not unique to the Soviet army or to a specific geographic location. Whether the reader is trying to learn more about the Soviet-Afghan war or to prepare himself and his soldiers for future combat, this book will not disappoint.

Major Mike Rose is Chief, Engineer Division of the Warfighter Department, at the Maneuver Support Center, Fort Leonard Wood. He previously served as a doctrine writer at the Engineer School after a tour as an observer/controller at the National Training Center, Fort Irwin, California.

Engineers in Task Force XXI

By Lieutenant Colonel Kevin Weddle, Lieutenant Colonel Cliff Farquhar, and Major Steve Gay

The 1st Brigade Combat Team, 4th Infantry Division, is conducting a predawn hasty attack on a dug-in enemy motorized rifle battalion. Late in the reconnaissance fight, the enemy commander unexpectedly changes his course of action. At 0200, with low illumination, the brigade commander decides on a high-risk, high-payoff night movement of the entire brigade to attack positions. He elects to move over some of the toughest terrain at the National Training Center (NTC). The attack kicks off at the right time, and the commander commands and controls the movement and attack despite total darkness and enemy-spoiling attacks. The brigade's main effort hits enemy defenses at the right location. Engineers breach multiple lanes in enemy complex obstacles in a matter of minutes. The mission is a success. On to the next challenge!

This scenario may sound like fiction, but in reality it was the next-to-last mission at the Task Force XXI Advanced Warfighting Experiment (AWE), which took place in March 1997. The night attack and its coordinated movements were made possible by the Appliqué system. The All-Source Analysis System and the Digital Topographic Support System (DTSS) provided terrain and enemy threat analyses, which allowed the main effort to hit the opposing force at its most vulnerable spot. The Grizzly (a visually modified M113)—along with some hard-working, well-trained, dismounted combat engineers—produced multiple breaches. This night attack illustrates the potential of the future digitized force. Engineers have been an integral part of this force from the beginning.

The Beginning

The Task Force XXI AWE process was an 18-month effort that will stand as the model for all future AWEs. It began in January 1995, when the Chief of Staff, United States Army, designated the 4th Infantry Division, Fort Hood, Texas, as the *Experimental Force* (EXFOR). The division designated the 1st Brigade Combat Team as *Task Force XXI*, which included the 299th Engineer Battalion. Early that spring, work began on a modified table of organization and equipment and task organization for a brigade combat team. An initial training plan was prepared with hundreds of milestones that would bring the brigade to the culmination of the AWE at the March 1997 NTC rotation. The brigade organization was finalized only weeks before our deployment to NTC. Brigade units included a light infantry task force, a mechanized infantry task force, an armored task force, an aviation task force, two field artillery battalions (direct and general support), an engineer battalion, a forward support battalion, an aviation support battalion, a brigade reconnaissance troop, and other combat support and combat service support units. The 4th Infantry Division Engineer Brigade, the 299th Engineer Battalion, and the U.S. Army Engineer Center began a parallel effort to develop tactics, techniques, and procedures for a digital engineer force.

The many engineer initiatives originally envisioned were pared to 12 systems or ideas tested by the 299th:

- Engineer organization
- Grizzly
- Appliqué

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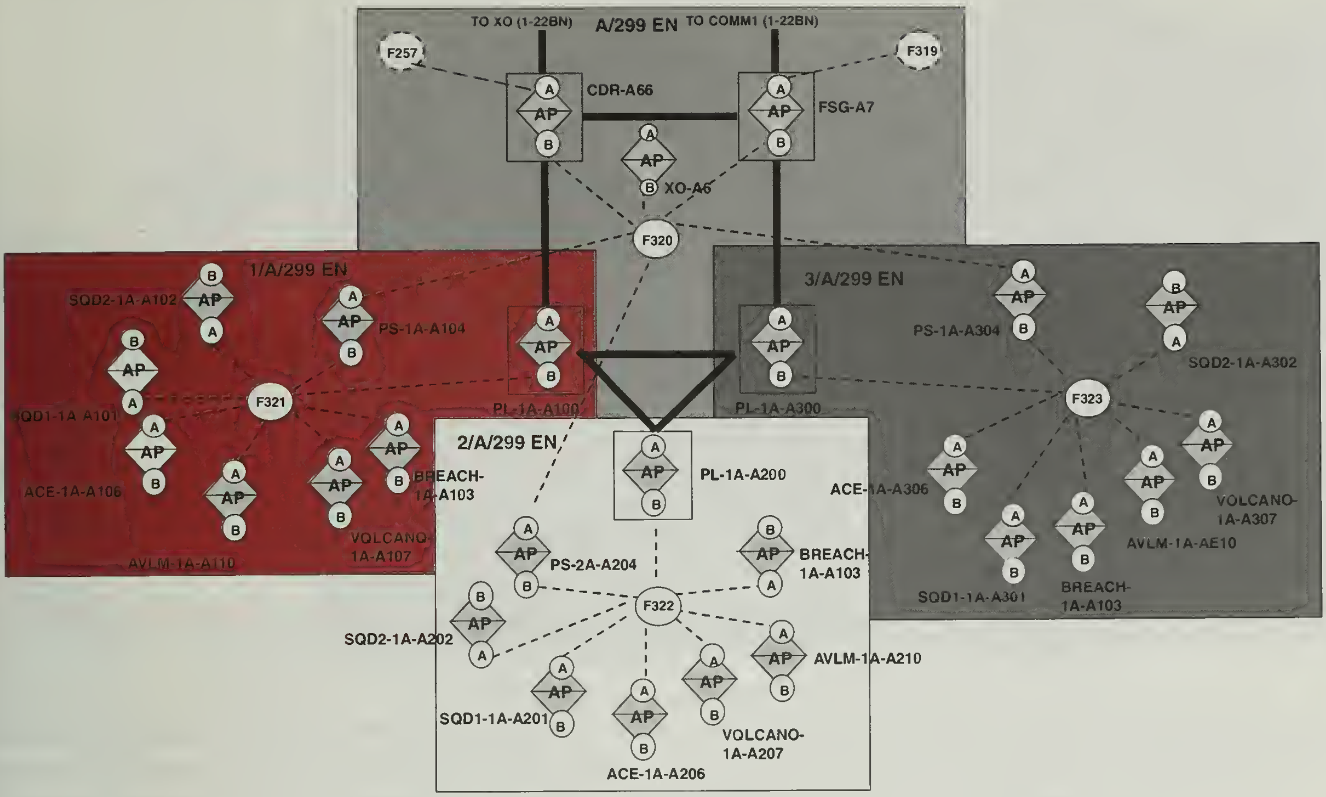

Figure 1. A Company, 299th Engineer Battalion, tactical internet

- Digital Topographic Support System
- Engineer Tactical Operations Center
- Maneuver Control System–Enhanced (MCS-E)
- Enhanced Position Locating and Recording System (EPLRS)
- Single-Channel, Ground-to-Air Radio System-Systems Improvement Program (SINCGARS-SIP)
- Battlefield Combat Identification System (BCIS)
- Hornet wide-area munitions

In addition to the new systems, the battalion also fielded the Volcano and 12 armored combat earthmovers (ACEs) to provide a permanent ACE/dozer mix of 12 and six, respectively.

Training

The training phase of the Task Force XXI AWE began in January 1996 with individual training for all brigade soldiers on the Appliqué, SINCGARS-SIP, and EPLRS systems. The brigade and the division set up a "digital university" (now called the *Computer Training Support Facility*), which was operated mainly by soldiers with significant support from contractors. The 40-hour courses operated 24 hours a day for a five-month period and reached virtually every soldier in the brigade. Concurrent with individual training, the brigade established an installation yard where soldiers began to install Appliqué, SINCGARS-SIP, global positioning system (GPS) receivers, and EPLRS into thousands of the brigade's vehicles. Literally thousands of man-hours were expended in individual training and the installation process. Normal battalion business continued throughout the AWE process—including exercise evaluations, a Battle Command Training Program exercise, and fire fighting.

After the Appliqué system was installed and basic Appliqué training was provided to soldiers, the brigade combat team "plugged in " the system to see if it worked. Through a series of connectivity exercises conducted during the summer of 1996, the brigade tested the tactical internet to see if it operated as planned. The tactical internet was the communications and positioning network (using SINCGARS-SIP and EPLRS as the communications "pipes" over which the digital and voice traffic passed) that provided the brigade's situational awareness. Figure 1 shows one company's tactical internet architecture. The brigade's soldiers and contractors achieved higher than a 95-percent success rate for Appliqué-equipped vehicles. To achieve situational awareness without constant contractor assistance, the brigade established exacting tactics, techniques, and procedures (TTPs).

After the brigade was connected, we conducted collective training with the new organization. During this training, the brigade incorporated tactical and digital TTPs that were written and developed over the previous 18 months, trained on

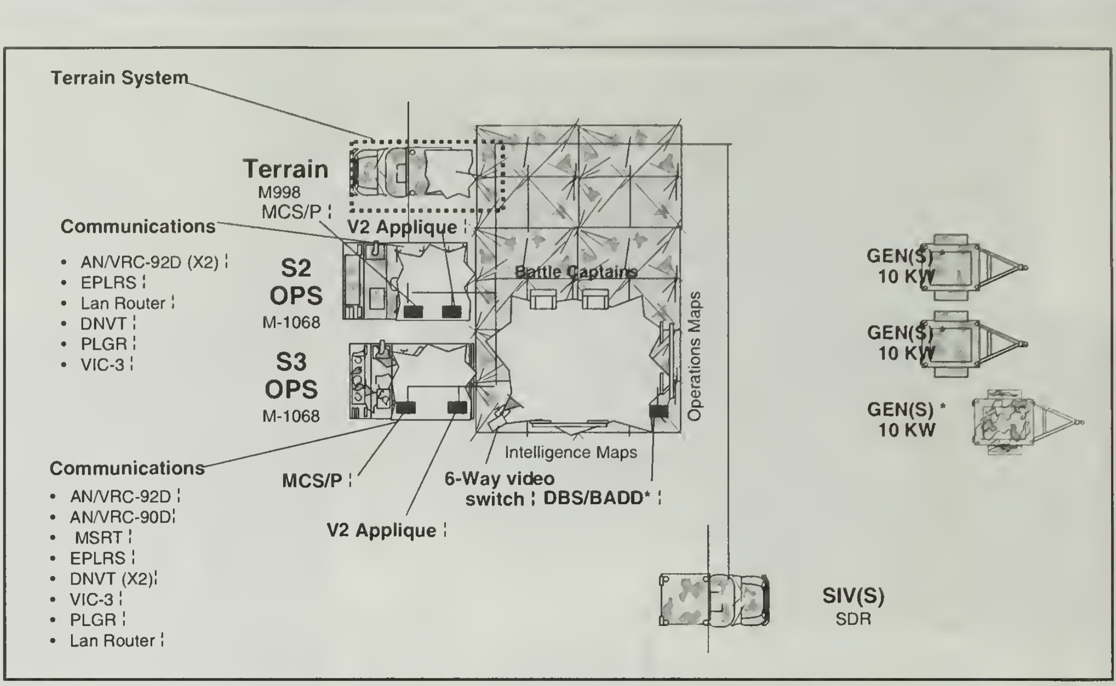

Figure 2. The 299th Engineer Battalion's tactical operations center

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and evaluated more than 100 initiatives, and conducted normal NTC train-up missions.

Our rotation was unique in several ways. We deployed most of the brigade's vehicles, had many VIPs and press in attendance, and conducted no live-fire. We conducted several standard NTC movements to contact, hasty attacks, and defenses in sector during the first five days of the rotation. After that, the brigade moved into a continuous operations phase, where we operated continuously in both time and space. We received missions every day without the usual "prep day" and operated over the entire NTC maneuver area. During two defenses, the brigade defensive sector stretched from the northern to the southern boundaries of NTC. This action was an attempt to stress the tactical internet and to determine if the brigade was capable of increased tempo, lethality, and survivability through the magic of digitization. While the brigade did not win every battle, the beauty of almost perfect friendly situational awareness paid off time after time.

Lessons Learned

After returning to home station, we conducted a series of lessons-learned sessions and internal after-action reviews. Here are a few of the things we found:

Appliqué: The Appliqué system worked well for friendly situational awareness. We are not aware of a single instance where an Appliqué-equipped unit got lost, missed a movement or link-up, or experienced any of the other mishaps that occur when soldiers operate and train. Much of this system's success is attributed to the noncommissioned officers (NCOs), who helped develop the plan and kept it on track. Red (enemy) situational awareness was less user friendly and less useful. The messaging component of th Appliqué system never worked very well. Overlays and lon messages were too large to move digitally over the tactica internet, which was often clogged with messages. The tactica internet was too rigid and could not be tailored to changin task organizations. Positioning and digital message dat moving over the Appliqué system often interfered with FM voices, degrading the range and quality. Fortunately, many c these problems have been solved or are being solved with th system that replaced Appliqué, the Force XXI Battl Command Brigade and Below System. Although its fu fielding to the 4th Infantry Division has been delayed, limite user tests show great promise. The future tactical internet wi have separate voice and data nets and will allow tas organization changes "on the fly."

Hornet: The Hornet wide-area munitions have grea potential for engineers. Throughout the AWE, the Horne affected the enemy commander's psychology, provided earl warning, reinforced conventional obstacles, disrupted enem forces, and was a lethal killer. We found that all engineer an maneuver scouts can emplace Hornets in the counte reconnaissance fight. The Raptor, which combines improve Hornets with sensors and communications gateways, wa successfully tested in simulation during the Division AWE.

Digital Topographic Support System (DTSS): Th HMMWV-mounted DTSS supported the entire brigade fro the engineer battalion tactical operations center (Figure 2 This system was manned by soldiers from the 29th Enginee Battalion (Topo), Hawaii, who provided outstandin topographic support to every brigade unit. Since DTSS di not have full digital connection to units throughout th brigade, we hand-delivered hard copies of topographi

This Grizzly is ready to conduct a breach.

products. These products were better than anything the task force and team commanders had previously experienced. To better support brigade units, we developed a "push-pull" system of support. Units could always request specific topographic products from the engineer terrain team, which worked well when commanders knew what they needed. We also developed a standard package of topographic products for delivery to each unit depending on the mission. The combination of these two methods worked well. Brigade commanders probably became the most "topo-knowledgeable" commanders in the Army because of the direct and responsive support they received. Even without a digital connection, DTSS proved itself throughout the AWE process. Due largely to the success of DTSS at the task force and division AWEs, the Army has provided funds for full connectivity with other Army Battle Command Systems and to field the DTSS down to brigade level.

Revolutionary Warfare

Many have judged the Task Force XXI experiment based solely on the outcome of NTC rotation battles. Unfortunately, this misconception negates the almost unbelievable performance of the soldiers in the 1st Brigade Combat Team. The AWE was a two-year effort with unprecedented personnel tempo. The brigade fielded literally hundreds of new equipment items, wrote and tested TTPs for digital equipment no one had ever seen, sustained itself, trained hard, and changed schedules daily. Individual soldier sacrifices were immeasurable. With the possible exception of the airmobile experiments of the early 1960s, no peacetime Army unit has accomplished so much in so little time as Task Force XXI. The AWE process allowed accelerated procurement of key systems and development of new and dynamic doctrine.

The AWE process is here to stay! If engineers are to remain an essential member of the combat arms, we must remain fully engaged. The 4th Infantry Division (EXFOR) continues to refine and improve the groundwork laid by Task Force XXI and the Division AWE. Thanks to the EXFOR, the Army will experience a revolution in warfare, not merely a predictable evolution in tactics.

Lieutenant Colonel Weddle is attending the Army War College at Carlisle Barracks, Pennsylvania. Previous assignments include commander, 299th Engineer Battalion; S3, 555th Engineer Group; S1, 7th Engineer Brigade; the Army Staff; and Assistant Professor of Military History at the U.S. Military Academy. LTC Weddle is a graduate of the U.S. Military Academy and holds a master's degree in civil engineering from the University of Minnesota.

Lieutenant Colonel Farquhar was executive officer of the 299th Engineer Battalion during the AWE. He previously served as a staff officer for USFK in Korea; led platoons in the 237th Engineer Battalion in Germany; and commanded D Company, 15th Engineers at Fort Lewis, Washington. LTC Farquhar was killed in an accident in December 1998. He will be greatly missed by all who served with him.

Major Gay is an engineer staff officer on the Central Command staff. Previous assignments include S3, 299th Engineer Battalion; platoon leader and company executive officer, 326th Engineer Battalion (Assault); A Company and Headquarters Company commander, 65th Engineer Battalion (Light); and assistant division engineer, 4th Infantry Division (Mech). MAJ Gay served as the battalion's executive officer during the Division Advanced Warfighting Experiment.

Bridge to the Future:

Tele-Engineering and the Bubiyan Bridge Assessment

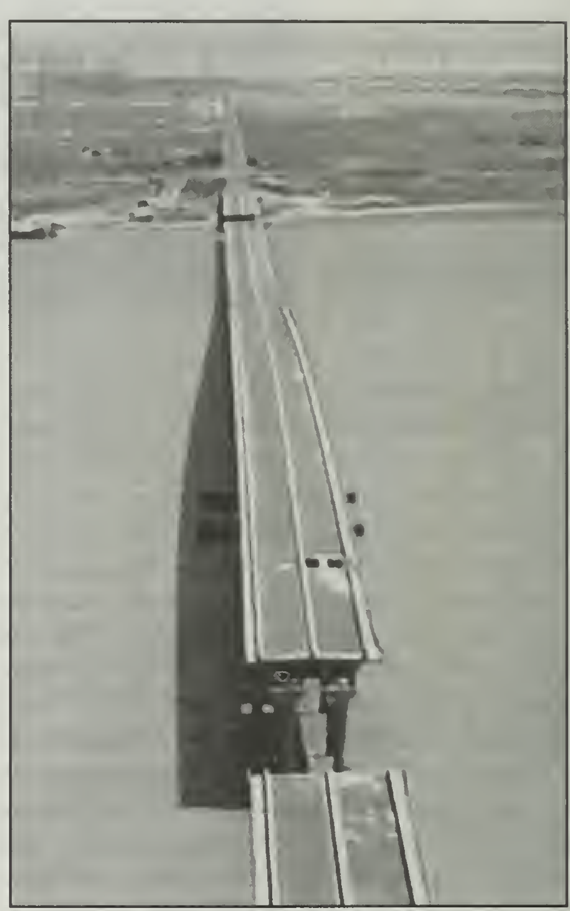
By Dr. Paul F. Mlakar Sr., James C. Ray, and Captain Todd C.

Tele-engineering is an emerging concept that uses state-of-the-art telecommunications to supplement theater of operations engineering personnel in remote locations with advice from Army subject matter experts. It serves engineering as telemedicine serves medicine.

A recent mission to plan the expedient restoration of the war-damaged Bubiyan Island Bridge in Kuwait clearly illustrates the capabilities of tele-engineering. Using this concept, engineers provided a fast, detailed technical assessment of a war-damaged bridge halfway around the globe. Future developments will expand the use of tele-engineering to significantly enhance and multiply the capabilities of our engineer forces worldwide.

The Concept

While tele-engineering is a new term, it is self-explanatory. It means "remote engineering," where a user in the field links with a subject matter expert at another location to solve an engineering problem. The need for such a capability has expanded as the complexity and technical requirements of military engineering have increased. There will be many instances where detailed engineer expertise and technical advice will be required for successful mission accomplishment. However, as the Army continues to downsize and reliance on a CONUS-based force increases, a complete engineer team of experts will not always be available. Tele-engineering solves this problem by establishing an engineering telepresence that allows engineers on the ground easy access to CONUS or OCONUS expertise.



Aerial view of the Bubiyan bridge from Bubiyan Island, showing the 80-meter gaps at each end.

If an engineer unit faces a technical challenge that is beyond the expertise of people on-site or beyond the scope of available engineer assets, solutions are "just a phone call away." Telecommunication links allow engineer units in the field to connect with appropriate engineer subject matter experts who can visualize a problem, engage in dialogue with individuals performing the work, and provide viable solutions. Solutions will draw on and exploit state-of-the-art technologies from the Army research and development (R&D) community, Department of Defense high-performance computing assets, the expertise of U.S. Army Corps of Engineers districts and divisions, the collective experience of the private sector construction industry, and the knowledge base of academia.

CONUS-based tele-engineering support from the Corps of Engineers R&D community will be available in the future from a central tele-engineering operations center. The current demonstration is being centrally facilitated by an interim operations center located at the U.S. Army Research and Development Center's Waterways Experiment Station (WES) in Vicksburg, Mississippi. This operations center will receive requests for assistance from the engineer force, activate standby subject matter expert teams or generate ad-hoc teams, track the teams' responsiveness, catalogue

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Substantial damage was identified to segments of the bridge between the two 80-meter gaps. The assessment team recommended over-bridging this 40-meter span with panel bridging.

responses to the requestors, and provide communications links between subject matter experts and requestors. The Tele-Engineering Operations Center will only respond to requests for support that are beyond the scope of the engineer assets available to the operation (including Corps of Engineers districts supporting the deployed engineers).

Bubiyan Island Bridge

In the spring of 1998, the Kuwaiti Ministry of Defence requested assistance from the U. S. Office of Military Cooperation-Kuwait to plan an expedient restoration of the Bubiyan Island Bridge that would accommodate light military traffic. The U.S. office asked personnel from the U.S. Army Engineer School for help, and they in turn called the Waterways Experiment Station. This project ultimately involved the Third Army Engineer Staff and the Corps of Engineers Transatlantic Programs Center as well. Execution of this mission demonstrates the outstanding capabilities and support available through tele-engineering.

The Kuwaiti Island of Bubiyan is strategically located in the northern Arabian Gulf adjacent to Iraq. Its only connection with land is a 2.4-kilometer bridge from the mainland of Kuwait across the Subiya Channel. The bridge is a precast, posttensioned, segmental concrete structure that was completed in 1983. It is unique in the three-dimensional frame of its segments. During the Gulf War, an 80-meter gap was created when an intermediate pier near the mainland was destroyed. Hostilities left a similar opening near the navigation pass at the island end of the bridge.

Assessment and Restoration

The WES staff began this assignment by searching for information on the bridge. Their search produced a technical journal article on its design and construction written by U. S. Federal Highway Administration engineers who had advised the Kuwaiti Ministry of Public Works. The article explained that the bridge had 11 viaducts, which were continuously posttensioned over five or six spans of 40 meters between piers. Each of these spans was formed from eight precast segments, which are space frames. The WES staff also contacted the designer-builder, who provided a documentary video and other valuable information.

An assessment team consisting of one person from WES and one from the Engineer School then visited Kuwait. They first met with the U.S. Office of Military Cooperation to establish specific requirements for bridge restoration and criteria to evaluate alternative concepts. The information acquired was confirmed in meetings with the Kuwaiti Ministry of Defence, who contributed valuable information about extensive damage to the bridge in addition to the two major gaps. This damage had been stabilized but not fully repaired after the Gulf War.

The next phase included a two-day reconnaissance of the bridge. The team accessed the remaining portion at the mainland directly, the part between the major gaps by helicopter, and the piece at the island by naval vessel. The team checked the as-built structure against the information previously acquired. They also inspected for damage affecting the capacity of the remaining spans. Their inspection revealed significant distortion of the bottom flange of the span adjacent to the major gap near the mainland. It also revealed substantial damage to segments of the bridge between the two major 80-meter gaps.

The information gathered in Kuwait was transmitted daily to WES by phone, fax, and e-mail. There, a subject matter expert team evaluated the capacity of the damaged structure to carry vehicular traffic. The team also assessed the ability of this structure to bear the additional loading of alternatives for

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the expedient bridging of the major gaps. This was accomplished with finite element analysis software developed by the WES.

Results of the WES analysis were sent to the team in Kuwait. The results indicated that the remaining bridge was capable of single-lane, military load class 40 traffic if the 40-meter span (between the two 80-meter gaps) that contained damaged segments was over-bridged with panel bridging. Three alternatives were evaluated to close the two 80-meter gaps:

- Expediently elevate a single intermediate damaged pier in each gap to the elevation of the remaining deck and construct four double-truss, single-story M2 Bailey spans of 40 meters each in the gaps.
- Raise the intermediate piers and erect four 40-meter spans of single-truss, single-story Mabey & Johnson Compact 200 bridging across the gaps.
- Leave the intermediate piers as they are and bridge the two 80-meter gaps with double-truss, double-story Mabey & Johnson Universal bridging.

The engineering staff of Mabey & Johnson in the United Kingdom provided valuable assistance in this evaluation through telecommunication links.

The assessment team briefed these results to the U.S. Office of Military Cooperation and then the Kuwaiti Ministry of Defence. Thanks to tele-engineering support, a detailed structural analysis and review of alternatives were accomplished within five days of the assessment team's arrival in Kuwait. The Kuwaiti Ministry of Defence took the results under advisement, and action to restore the bridge awaits their decision.

Data Collection

While tele-engineering was not the main objective of the Bubiyan Bridge project, it provides an excellent example of the concept's potential. This project reinforced the fact that data collection and transmission are key parts of tele-engineering. Without high-resolution data, a reliable off-site assessment of a problem is extremely difficult, if not impossible, to achieve.

From the onset of the Bubiyan project, lack of detailed data was a problem. Digital photographs of the bridge and the damaged spans were all that were initially supplied. While the photos were of high quality and provided a good overview of the problem, the research staff misinterpreted them. The photos made the structure appear to be a conventional steel deck truss with reinforced concrete deck, which was far from the truth. Also, the photographers concentrated mostly on the gaps and took few shots of the remaining spans, which were critical to the problem.

Detailed information was required for an in-depth assessment of this complex structure. Structural design or as-built drawings were not available. Since reinforcing and prestressing are hidden in concrete structures, on-site reconnaissance data lacked sufficient detail for the required structural analyses. Thus the journal article and documentary video obtained by WES were the best sources of information. An important aspect of tele-engineering is that the subject matter expert often must supplement data from the remote site using his own sources, contacts, and expertise.

The Benefits

The Bubiyan Island Bridge project shows the great benefits and unlimited potential of tele-engineering. It promises to be a versatile tool for deployed engineer units in combat support, peacekeeping, and humanitarian operations where immediate technical expertise is required for unique problems. Equally important, the Bubiyan project brought out shortcomings and some needed improvements for tele-engineering. Successful tele-engineering operations depend on detailed data provided to off-site subject matter experts so they clearly understand the problem. Their "eyes" to the problem are those of the on-site engineer, who must carefully and fully describe the problem to them. This level of data transfer requires fast, reliable, and high-capacity communication capabilities, including phone, fax, Internet, and e-mail. This level of communications is probably the foremost challenge, because military operations usually occur in remote areas and Third World countries where communication links are minimal. High-capacity communication was a problem even in the well-developed country of Kuwait. Although links existed, there were too few of them, and they were used for higher-priority purposes.

With the assistance of tele-engineering, a two-man field reconnaissance team at Bubiyan Bridge was able to provide an accurate, expert assessment of the damaged bridge in only a few days, saving thousands of dollars in travel and engineering expertise. In wartime operations or operations other than war, tele-engineering will help soldiers in the field solve a wide spectrum of problems by tapping engineering expertise from sources thousands of miles away. Such tele-engineering mission solutions will save time and money as well as the lives of our soldiers, allies, and civilians.

Dr. Mlakar is chief of the Concrete and Materials Division at the Waterways Experiment Station.

Mr. Ray leads the bridge research and development program at the Waterways Experiment Station.

Captain Liebig commands D Company, 35th Engineer Battalion at the U. S. Army Engineer Center.

CTC Notes

National Training Center (NTC)

Integration of Obstacle Design and Fires

By Major Frederick J. Erst

Both maneuver and engineer units have difficulty achieving obstacle integration during engagement area development at the National Training Center (NTC). Most obstacle groups lack sufficient density and are not integrated with effective direct and indirect fires. As a result, they are rapidly bypassed or reduced by enemy engineers. However, when maneuver and engineer units understand the task and purpose of fires for each obstacle group design, they can achieve the intended obstacle effect of *disrupt, fix, turn,* or *block* on the enemy's formation.

Design

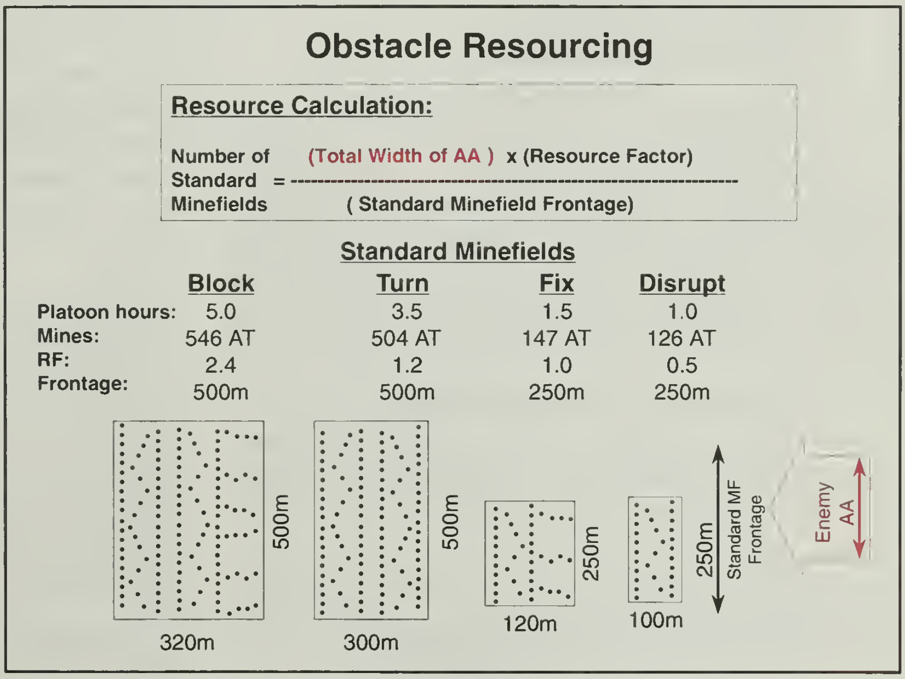
Tactical obstacle design is based on the formation of the attacking enemy and the intended obstacle effect. During task force defensive planning, the assistant task force engineer should design and array each obstacle group based on the commander's intended obstacle effect, the resource factor (RF), and the total width of the avenue of approach (AA). Use the obstacle group design calculation in FM 90-7, *Combined Arms Obstacle Integration*, to determine the total quantity of standard minefields required to achieve the intended effect (Figure 1).

Antivehicular obstacles, such as antitank ditches or 11-row concertina roadblocks, may be substituted for as much as 20 percent of the standard minefields in a group. Plan to use scatterable mines such as Volcano, MOPMS, and ADAM-RAAM or special purpose munitions such as Hornet as part of the minefield groups. These mines and munitions also can reinforce an avenue of approach to counteract an expected enemy penetration. The key is to array the obstacle groups with sufficient depth and density so they will manipulate the enemy's maneuver in the desired direction.

During the defense, the engineer battlefield assessment (EBA) often focuses on friendly engineer capabilities and does not address the impacts of terrain or the enemy engineers' breaching capability. Engineer platoons can use the EBA to design obstacles that will defeat enemy breaching assets. Or platoons can use a combination of "more visible" and "unseen" obstacles in each obstacle group to manipulate enemy maneuver in the desired direction. They can use the countermobility time line to emplace specific obstacles during the day (or at night) based on expected enemy reconnaissance in sector.

Obstacle Integration

Effective obstacle integration begins with the commander's intended effect of the obstacle on the enemy's maneuver. This effect should include the enemy target, the specific obstacle effect, and the relative location of the



Obstacle Resourcing

Resource Calculation:

$$\text{Number of Standard Minefields} = \frac{(\text{Total Width of AA}) \times (\text{Resource Factor})}{(\text{Standard Minefield Frontage})}$$

Standard Minefields

	Block	Turn	Fix	Disrupt
Platoon hours:	5.0	3.5	1.5	1.0
Mines:	546 AT	504 AT	147 AT	126 AT
RF:	2.4	1.2	1.0	0.5
Frontage:	500m	500m	250m	250m

Figure 1

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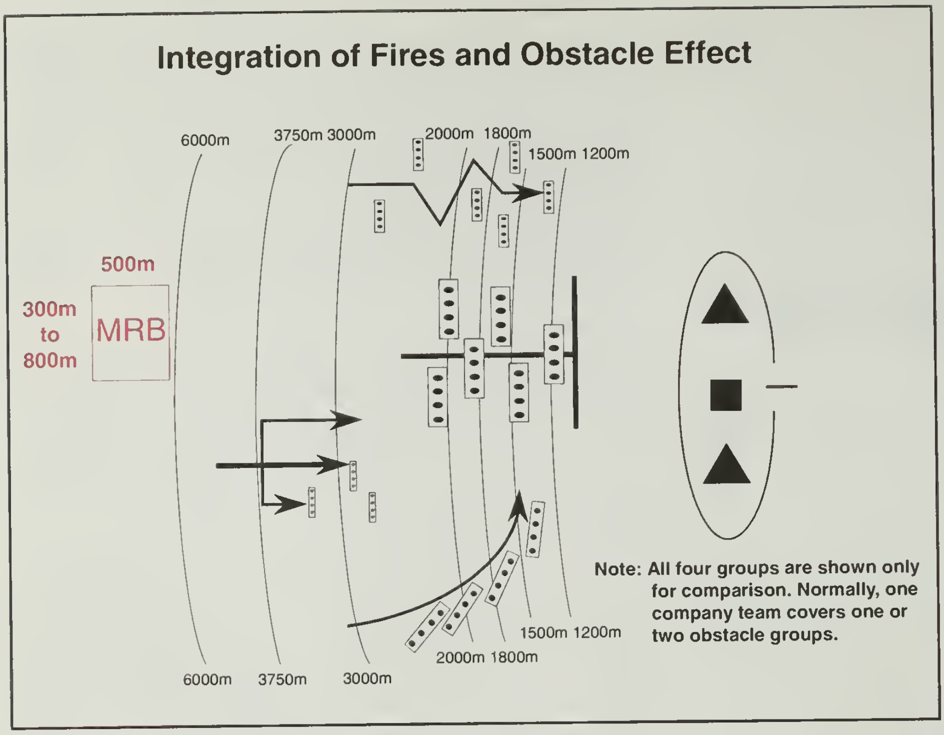


Note: All four groups are shown only for comparison. Normally, one company team covers one or two obstacle groups.

Figure 2

obstacle. The method to achieve this effect is to integrate obstacles with direct and indirect fires and manipulate enemy maneuver in the desired direction. The end state is for each company team to kill at least one enemy battalion while remaining combat effective. The maneuver commander's intent must specify locations *where* he wants to affect the enemy's maneuver. The engineer must ask the commander four questions during engagement area development:

- Where does the enemy want to go?
- Where should the enemy go?
- Where should the enemy not go?
- Where do you want to kill the enemy?

At the task force level, the maneuver commander uses obstacle groups to graphically portray the obstacle effect. Figure 2 depicts weapon ranges from a company-team battle position to each type of obstacle group. The four groups are shown for comparison only. Normally, one company team covers one or two obstacle groups with direct fires.

Integrating Obstacle Groups and Direct Fires

Effective units emphasize the use of the following three techniques to successfully integrate obstacle group design with direct and indirect fires:

- Obstacle siting.
- Obstacle ownership.
- Fire-control plan (direct and indirect fires).

Obstacle Siting

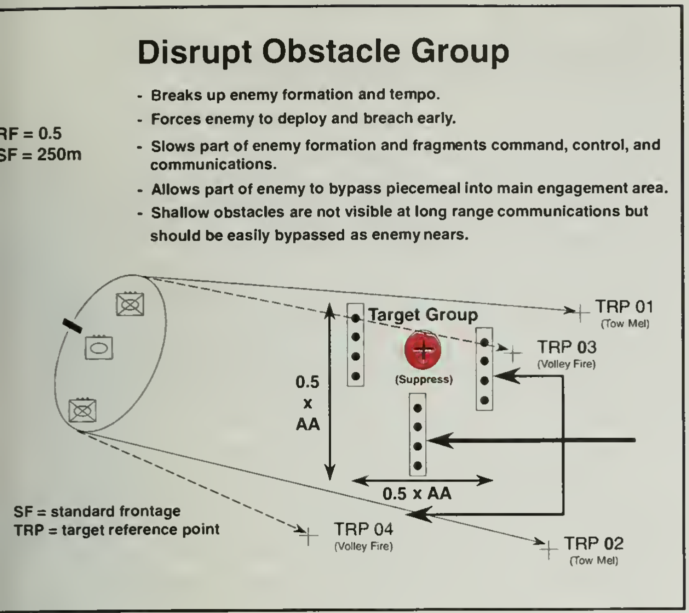
Obstacle integration begins during obstacle siting. The maneuver company team that overwatches a particular obstacle group must understand the intended obstacle effect and the type of direct and indirect fires required to achieve that effect. The company team and the engineer platoon must work together to position each obstacle in the group using the direct fire plan and the initial obstacle group design. Based on the terrain, the company team commander, the fire-support officer, and the engineer platoon leader adjust obstacle locations to ensure that the group is covered by direct and indirect fires and that the group design is consistent with the task force commander's intent. Use the obstacle siting procedure described in FM 90-7.

Obstacle Ownership

"Ownership" of the obstacle group by the company team begins with obstacle siting and continues through obstacle turnover. While the obstacle group is emplaced by an engineer platoon, the actual "owner" is the company team overwatching the obstacles. The company team should provide security and manpower for fratricide fence construction or mine-dump operations for their own obstacle group. This technique allows the engineer platoon to focus on its primary mission of emplacing minefields. It also allows the company team leadership to account for, equip, transport, and supervise its own personnel. The company team is then better prepared for obstacle turnover and land closure during the battle and for obstacle recovery after the fight. Ownership ensures that the company team remains integrated throughout the entire process; it results in better integration of the obstacle group with fires.

Fire-Control Plan

Engineers must know weapons' ranges and capabilities; they must also understand and use the same fire-control terminology as their maneuver counterparts. When engineer platoon leaders are asked, "How far should an obstacle be positioned from the overwatching unit?" most will answer, "Two-thirds of the maximum effective weapons range." However, their response should also include the task and purpose of direct and indirect fires for the obstacle group design needed to achieve the obstacle effect. An engineer platoon leader who can confidently talk about direct fire-

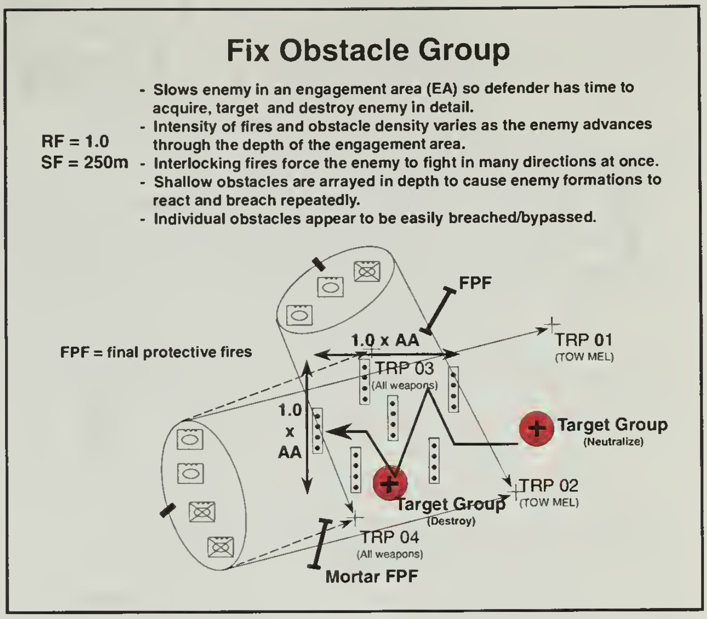

Disrupt Obstacle Group

- Breaks up enemy formation and tempo.
- Forces enemy to deploy and breach early.
- Slows part of enemy formation and fragments command, control, and communications.
- Allows part of enemy to bypass piecemeal into main engagement area.
- Shallow obstacles are not visible at long range communications but should be easily bypassed as enemy nears.

RF = 0.5
SF = 250m

SF = standard frontage
TRP = target reference point

Figure 3

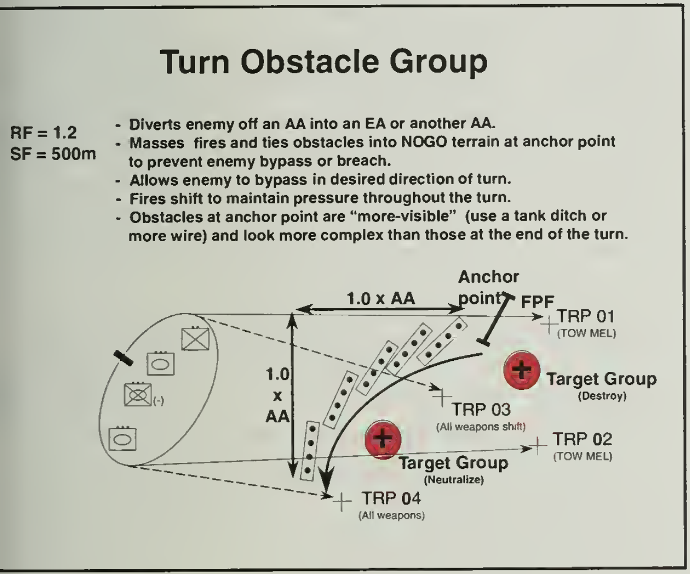

Fix Obstacle Group

- Slows enemy in an engagement area (EA) so defender has time to acquire, target and destroy enemy in detail.
- Intensity of fires and obstacle density varies as the enemy advances through the depth of the engagement area.
- Interlocking fires force the enemy to fight in many directions at once.
- Shallow obstacles are arrayed in depth to cause enemy formations to react and breach repeatedly.
- Individual obstacles appear to be easily breached/bypassed.

RF = 1.0
SF = 250m

FPF = final protective fires

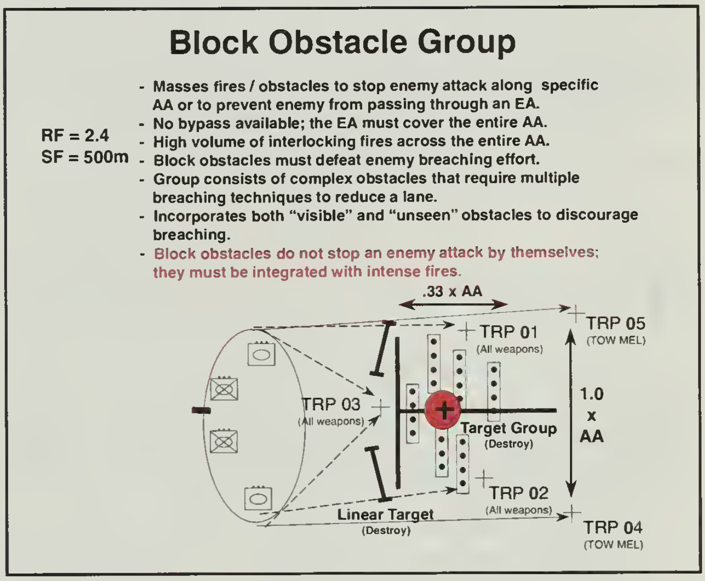
Figure 4


Turn Obstacle Group

RF = 1.2
SF = 500m

- Diverts enemy off an AA into an EA or another AA.
- Masses fires and ties obstacles into NOGO terrain at anchor point to prevent enemy bypass or breach.
- Allows enemy to bypass in desired direction of turn.
- Fires shift to maintain pressure throughout the turn.
- Obstacles at anchor point are "more-visible" (use a tank ditch or more wire) and look more complex than those at the end of the turn.

Figure 5


Block Obstacle Group

RF = 2.4
SF = 500m

- Masses fires / obstacles to stop enemy attack along specific AA or to prevent enemy from passing through an EA.
- No bypass available; the EA must cover the entire AA.
- High volume of interlocking fires across the entire AA.
- Block obstacles must defeat enemy breaching effort.
- Group consists of complex obstacles that require multiple breaching techniques to reduce a lane.
- Incorporates both "visible" and "unseen" obstacles to discourage breaching.
- Block obstacles do not stop an enemy attack by themselves; they must be integrated with intense fires.

Figure 6

control measures (such as maximum engagement lines) or discuss the type of indirect fires on an obstacle group, can effectively assist the company team commander when he develops his fire-control plan.

The four types of obstacle effects (disrupt, fix, turn, and block) require a different combination of direct and indirect fires to achieve the commander's intent. The engineer platoon and the company team must understand where fires must be massed, distributed, and shifted within the obstacle group. Both must understand how the obstacle group is designed to manipulate the enemy's maneuver in the desired direction. Figures 3 through 6 combine engineer considerations for obstacle group design with the specific direct fire-control measures needed for each obstacle effect, as shown in FM 90-7.

Summary

To ensure mission success, units must ensure that obstacle integration is an integral part of engagement area development. The engineer must understand fire-control planning, and the maneuver commander must understand obstacle-group design. Both the engineer and the maneuver unit must work closely together throughout the engagement area development process. By improving their understanding of the task and purpose of fires for each type of obstacle group design, commanders can achieve the intended obstacle effect of disrupt, fix, turn, or block on the enemy's formation.

Major Erst is the assistant brigade engineer trainer at the National Training Center, Fort Irwin, California. He previously served as a company commander in the 3rd Engineer Battalion and 10th Engineer Battalion and as a platoon leader/company XO in the 4th Engineer Battalion. He is a graduate of the University of Central Florida.

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Training for the Field: Squad Drill Certification

By Captain Keith W. Ensley

As usual the squad simulation training exercise (STX) was wedged tightly among several equally demanding events, and we had two new squad leaders. It was reminiscent of my first squad STX, which had gotten off to a shaky start about nine months before. Then, looking hard at the short-range calendar, we had carved out two days to train and rehearse squad drills. Our train-up had been simple, well-planned, and predictably painful to execute. Performed on Wednesday and Thursday, we had left Friday for precombat checks and inspections.

When we rolled to the field on Monday, I fully expected this STX to be a repeat of the previous one. But one difference was immediately apparent: rehearsals. In the previous STX, we had to pressure the squads to rehearse. This time they sprang into their rehearsal sequence with a purpose. Maybe they anticipated getting hammered by the evaluators the next day.

The slaughter never came. The squads conducted the lanes like practiced veterans—all of them. What was different?

The Secret

There was no secret—for the second STX, we adhered to time-tested doctrine. As FM 25-101, *Battle-Focused Training*, puts it, "Train the trainer to train his soldiers." Step two of the eight-step training model addresses the training and certification process. Our drill certification went even further by finishing with a fully evaluated rehearsal. The eight training steps are—

1. **Plan the training**
2. **Train and certify leaders**
3. **Reconnoiter the site**
4. **Issue the plan**
5. **Rehearse**
6. **Execute**
7. **Conduct an after-action review (AAR)**
8. **Retrain**

The Groundwork

The certification planning process begins by identifying the tasks to be trained. This is significantly easier if the company or battalion has a standard drill book. We isolated the following drill book tasks to evaluate in our squad STX:

- ☐ Conduct Squad-Level Troop-Leading Procedures (TLPs)
- ☐ Place a Row in a Hasty Row Minefield
- ☐ Construct a Standard Antivehicular Wire Obstacle
- ☐ Create a Hasty Road Crater
- ☐ Deploy a Modular Pack Mine System (MOPMS) with Remote-Control Unit (RCU)
- ☐ Perform Target Turnover Using STANAG (DA1355R)
- ☐ Perform a Minefield Strip Feeder Report
- ☐ Breach a Minefield Using Hand-Emplaced Explosives
- ☐ Breach a Wire Obstacle With a Bangalore Torpedo
- ☐ Mark a Cleared Lane in a Minefield
- ☐ Conduct an Enemy Obstacle Reconnaissance
- ☐ React to Contact

We then clumped these tasks into four mission scenarios. With only a few qualified evaluators, we limited ourselves to four stations. "Conduct Troop-Leading Procedures" was trained at all stations, and we grouped the other tasks as follows:

Station One

- ☐ Place a Row in a Hasty Row Minefield
- ☐ Perform a Minefield Strip Feeder Report
- ☐ Perform Target Turnover Using STANAG (DA1355R)

Station Two

- ☐ Construct a Standard Antivehicular Wire Obstacle
- ☐ React to Contact (Seven Forms of Contact)

Station Three

- ☐ Create a Hasty Road Crater
- ☐ Deploy a Modular Pack Mine System (MOPMS) with Remote-Control Unit (RCU)

Station Four

- ☐ Conduct an Enemy Obstacle Reconnaissance
- ☐ Breach a Minefield Using Hand-Emplaced Explosives
- ☐ Breach a Wire Obstacle With a Bangalore Torpedo
- ☐ Mark a Cleared Lane in a Minefield

The Plan

The figure on page 51 shows a two-day squad certification plan. The squad leader's brief to the commander and first sergeant on Day 1 are essential for successful certification. After squad leaders complete this session, they are ready to lead their squads with confidence. At the end of Day 1, participants understand the unit standard.

Two-Day Squad Certification Plan

Day 1 (Wednesday)

0400 Squad leaders brief drills to chain of command
0800 Squad leaders brief drills to their squads
1400 Squads gather training aides

Day 2 (Thursday)

0800 Set up training sites
0930 Execute graded drills (rotation)

A sand table is the perfect tool for drill briefings. Our first sergeant oversaw construction of an excellent sand table in our common area. After squad leaders are certified, they should sand-table-brief their squads as well. When soldiers visualize a task, they perform it much better the first time.

The schedule on Day 2 is designed to allow about 2.5 hours per rotation. This is ample time to conduct good TLPs and a quality AAR. Day 2 is a long one. Plan logistics to support a day filled with retraining and reevaluation. It is important to evaluate tasks to standard and allow time for AARs, so that squads clearly recognize their shortcomings when they leave.

The Exercise

Our squad leaders' briefing event began at 0400 hours around the company sand table, with squad leaders and above attending. Every squad leader briefed every drill. The repetition built confidence and reinforced comprehension. There was time for discussion, argument, synchronization, and compromise. Squad leaders left the sand table knowing the battalion drill and company standard.

Next, squad leaders walked their squads through all of the drills on a sand table. Squad leaders coordinated use of the company and battalion sand tables. Soldiers thrive on this special attention; it's an effective, professional touch that they respect.

Squads were assigned testing stations to set up. After coordinating with that station's evaluator, they used Day 1 to gather and load resources for their station.

Day 2 began with constructing the testing stations. Our post has several nearby training areas for unscheduled, small-unit training. These sites afford excellent opportunities to save mileage, maximize daylight, and respond to flexible training needs.

After stations were constructed, squads rotated through them according to a schedule. Each evaluator issued a scenario and mission fragmentary order. Squads conducted standard lane training complete with TLPs, to-standard execution, AARs, and retraining. Evaluators had the latitude to repeat an event at any point if the squad's execution was off the mark.

We prepared soldiers to spend a long day and served chow in the training area. It was important for them to complete all tasks to standard. They appreciated the company's dedication to uncompromising training.

Suggestions

The following suggestions will help ensure a successful squad certification:

☐ Schedule squad certification quarterly.

☐ Schedule this event as closely as possible to another evaluated event (squad STX, platoon STX, training center rotation, etc).

☐ Assign the company first sergeant as the master trainer for this event.

☐ During training quarters without another exercise, concentrate on tasks from the mission-essential task list that often are neglected during bigger events.

☐ Deploy a company tactical command post or tactical operations center to control rotations, filter distracters, and diffuse potential problems.

☐ Set up stations to support separate sections (dig teams, Class IV/V teams, etc.).

The Aftermath

Squad certification is not designed to be an end in itself; it serves as a refresher course and prepares soldiers for larger events. A key point is to capture the lessons of Day 2 before the day ends. Once the troops are gone, gather the squad leaders in the commander's or first sergeant's office and discuss the exercise. Use this time to direct squad rehearsals and make changes to the squad certification plan. When you observe squad rehearsals later, check to see if the group's advice was incorporated. Without a doubt, you'll see an improvement in the rehearsals!

Captain Ensley is serving in the Headquarters, Combat Maneuver Training Center in Germany. He previously commanded in the 1st Engineer Battalion at Fort Riley, Kansas.

References:

1. FM 25-101, *Battle-Focused Training* (Chapter 4, Drills/Lane Training).

2. ARTEP 5-145-*Drill Lane Training Methodology and Example Drills*.

3. TC 5-150, *Engineer Qualification Tables* (Tasks and Battle Drills).

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Directorate of Training Development (DOTD)

Engineer Unit Directory. The Engineer Unit Directory has been updated and is available at http://www.wood.army.mil/DDD/ddd.htm. Revisions or corrections to the directory may be sent to bakern@wood.army.mil. POC is Sandy Gibson, -4100.

Engineer Museum

Museum Guide. Visitors to Fort Leonard Wood are cordially invited to visit the Engineer Museum, which was established here in 1989 when the Engineer School moved from Fort Belvoir, Virginia. The museum includes an encyclopedic gallery, a chronological gallery, and a World War II historic community.

The encyclopedic gallery displays pieces of the material culture of American engineers. Five aspects of the Army engineer mission are highlighted: topographic engineering, land-mine warfare, tactical bridging, demolitions and explosives, and arms and armaments.

In the chronological gallery we interpret the history of Army engineers throughout America's history. We concentrate on the Battle of Yorktown during the American Revolution, westward expansion and the Mexican-American War, the Civil War, World Wars I and II, the Korean Conflict, and Vietnam War.

The World War II historic community interprets the history of Fort Leonard Wood. It includes 13 World War II-era temporary mobilization buildings, such as barracks, a mess hall, day rooms, and a historic chapel.

You may also visit our web page at: www.wood.army.mil/museum. POC is Kim Combs, 6-0780.

News and Notes

Obstacle Control Points. During a recent Warfighter exercise, the 3rd Infantry Division, Fort Stewart, Georgia, learned that obstacle coordination points are critical to the synchronization of Corps obstacle plans. The doctrinal foundation for an obstacle coordination point is in FM 101-5-1, *Operational Terms and Graphics.* The 18th Airborne Corps engineer section has written a document that explains the engineer interpretation of a coordination point as a place where leaders coordinate their obstacle effort across division and corps boundaries. An article describing their interpretation will appear in a future issue of *Engineer.* POC is CPT Kevin Pettet, (910) 396-5717.

Director of Public Works (DPW) Apprenticeship Program. Ten soldiers from the 864th Engineer Battalion, Fort Lewis, Washington, recently completed a one-month apprenticeship with the post's DPW. Each participant (electricians, plumbers, and equipment operators) was attached to a three-person crew that responded to service calls throughout the post. In addition to receiving valuable training in their MOS, the soldiers saved the DPW about 300 man-hours of labor and executed more than $20,000 worth of work. The 864th and DPW plan to provide additional soldiers with this unique training opportunity in the near future. POC is CSM William McDaniel, (253) 967-4483.

MANSCEN and Engineer School Directory

Fort Leonard Wood is making organizational changes to accommodate the arrival of the Chemical and Military Police Schools and to prepare for the Maneuver Support Center (MANSCEN), which will stand up on 1 October 1999. The following interim directory is a partial list of key offices at Fort Leonard Wood. Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

MANSCEN Commander and Engineer School Commandant
MG Robert B. Flowers
563-6158

MANSCEN and Engineer Center Command Sergeant Major
CSM Robert M. Dils
563-6149

MANSCEN and Engineer School Chief of Staff
COL Robert L. Davis
563-6118

Maneuver Support Center

Garrison Commander
COL Tim Daniels
563-4005

Directorate of MANSCEN Combat Developments
COL Leonard Izzo, Director
563-4009

  Engineer Division
  COL David Kingston, Chief
  563-4076

Directorate of Training Development
COL Rex Forney Jr., Director
563-4111

Department of Common Leader Training
COL Marsha Killam, Director
563-4123

Maneuver Support Battle Laboratory
COL Gregory Bean, Deputy Director
563-4082

TRADOC Program Integration Office, Terrain Data
COL William Pierce, Director
563-4086

  Terrain Visualization Center
  LTC Earl Hooper, Chief
  563-4077

MANSCEN Safety Office
Fred Fanning, Director
596-0116, DSN 581-0116

Engineer School

Assistant Commandant
COL M. Stephen Rhoades
563-6159

Deputy Assistant Commandant, Army Reserve
COL Michael Adams
563-4033

Deputy Assistant Commandant, Army National Guard
COL Harry Bryan
563-4034

1st Engineer Brigade
COL Thomas Luebker, Commander
596-0224, DSN 581-0224

Liaison Officers

Australian Army, LTC Phil Vandermoezel
563-6132

British Army, COL Phil Lilleyman
563-4018

Canadian Army, MAJ Paul Fleet
563-4017

French Army, COL Yves LeCouster
563-4027

German Army, LTC Helmut Bach
563-4029

Directorate of Training
COL William A. Van Horn, *Director*
563-4093

  Engineer Personnel Proponency Office
  Victoria Anthony, Chief
  563-4087

  Department of Instruction
  LTC Michael Conrad, Chief
  563-4119

  Total Army School System Division
  MAJ Victor Stephenson, Chief
  563-4106

  Doctrine Development Division
  MAJ Scott Spellmon, Chief
  563-4106

  Countermine Training Support Center
  David Dunstedter, Chief
  563-4123

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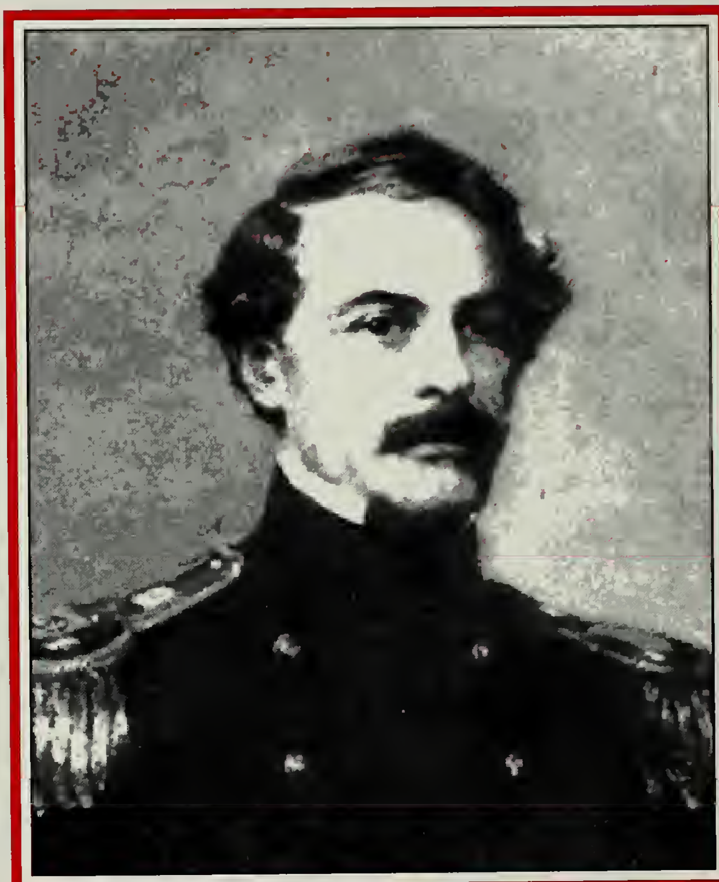
ARMY VALUES

Honor

"A military, or naval man, cannot go very far astray, who abides by the point of honor."
Admiral Raphael Semmes



Robert E. Lee

U.S. Army Corps of Engineers, 1829-1855
General, Confederate Army, 1861-1865

He was a foe without hate, a friend without treachery, a soldier without cruelty, and a victim without murmuring. He was a public officer without vices, a private citizen without wrong, a neighbor without reproach, a Christian without hypocrisy, and a man without guilt. He was Caesar without his ambition, Frederick without his tyranny, Napoleon without his selfishness, and Washington without his reward.

Benjamin H. Hill - 1832-1882 - Tribute to R.E. Lee

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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

August 1999

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Disaster Relief

Headquarters, Department of the Army
PB 5-99-3 Approved for public release, distribution is unlimited.

CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

The ENFORCE Conference was a spectacular success this year. The tactical twilight tattoo presented by the 1st Engineer Brigade was the highlight of an event-filled week. On behalf of the entire Engineer Regiment, thank you for a job well done!

We are continuing to work on modernizing our engineer fleet of equipment and need the support of the entire regiment to ensure funding in the near term for the Grizzly, Wolverine, Digital Topographic Support System, Maneuver Control System-Engineer, and Engineer Bradley Fighting Vehicle.

The *Grizzly* provides the Army with a responsive, complex obstacle-reduction system to support our heavy divisions. This complex obstacle-breaching vehicle integrates advanced countermine and counterobstacle capabilities on the M1 tank chassis. The first unit equipped will be the 8th Engineer Battalion, 1st Cavalry Division, Fort Hood, Texas, in the 3rd quarter, FY04.

The *Wolverine Heavy Assault Bridge* gives modernized forces the capability to cross gaps up to 24 meters wide. It will keep pace with the maneuver force and replace the AVLB on a one-for-one basis, with four assigned to each mechanized engineer company. The Wolverine is the first system to have a fully embedded digital command and control capability. The first unit equipped will be the 528th Engineer Battalion, 4th Infantry Division, Fort Hood, Texas, in September 2000.

The *Digital Topographic Support System* provides the capability to achieve information dominance throughout the battlefield. It will provide commanders and their staffs with digital graphic overlays that support their information systems. Fielding for this system started in FY96 and will continue through FY01.

The *Maneuver Control System-Engineer* rapidly provides commanders and their staffs with more accurate decision aids and planning tools than is built into the current Maneuver Control System. Funding for this system will ensure that digitized engineer command and control systems support maneuver commanders.

Fielding of the *Engineer Bradley Fighting Vehicle* will allow mounted engineers to increase their survival from the start of breaching operations through final reduction of the obstacle. The increased lethality of the M2A2 over the M113A3 makes the Bradley a logical choice for the engineer squad vehicle (see article, page 18.)

We continue to modernize the infrastructure at Fort Leonard Wood. Most warehousing and industrial operations currently are located in 62 World War II wood buildings in a 60-acre area of the post. To replace those facilities, we have proposed that a business research park be constructed in the same area, which would encompass 250 acres. Fort Leonard Wood would provide a developer with a long-term lease of the land and access to the infrastructure to expand the current facility and construct the research park. Potential benefits to the Army include state-of-the-art warehousing and industrial operations facilities. These facilities would reduce manpower and operating costs, reduce infrastructure overhead costs through cost sharing with industry, and improve job opportunities for soldiers and their family members. We believe that economic development of this area will improve the overall quality of life for soldiers and their families stationed at Fort Leonard Wood.

I'm extremely proud of the Engineer Regiment's support to our nation. In addition to our forward deployed forces overseas, we currently have soldiers deployed to 80 countries around the world. Due to the diversity of our regimental mission, engineers are found at nearly every location. You can take great pride in knowing that these soldiers received their training at Fort Leonard Wood. Currently, numerous engineer units from Germany and Fort Leonard Wood are deploying to Albania and Macedonia in preparation for peacekeeping operations in Kosovo. I ask you to keep them in your prayers. Essayons!

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Engineer

August 1999 Headquarters, Department of the Army Volume 29 PB 5-99-3

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

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Front Cover: *Soldiers help clean up Central America after Hurricane Mitch.*

Back Cover: *Historical example of the Army value "Integrity."*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER's e-mail address is: eubanksc@wood.army.mil. Our Internet home page is located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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Joint Engineers in Disaster Relief: Hurricane Mitch Slams Central America

By Lieutenant Colonel Robert W. Nicholson

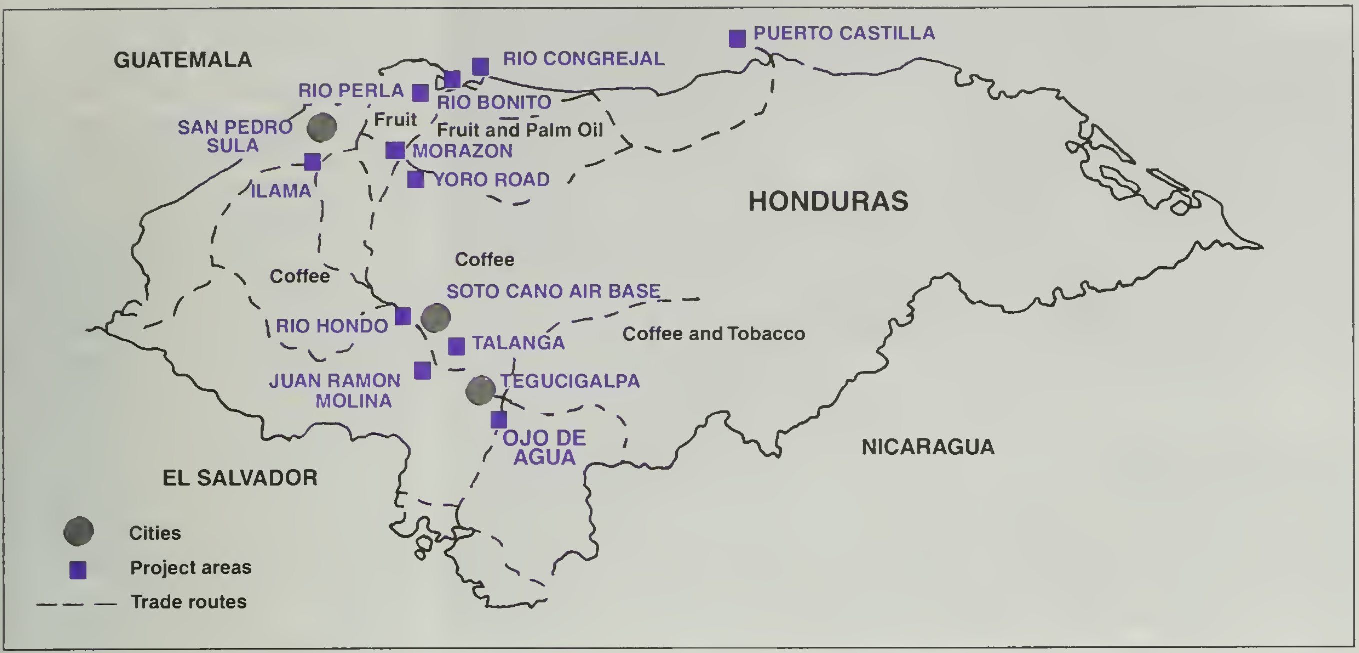
The damage and destruction that Hurricane Mitch wrought on Central America was of biblical proportions. The hurricane—called a 200-year-plus storm because it was the most devastating one to hit Central America in recorded history—was a category five event. Unlike most hurricanes, it did not render a swift, powerful blow to a contained area but spent a week meandering across the isthmus dumping huge amounts of rain. Very few infrastructures are engineered to withstand this type of event, much less those of underdeveloped countries in Central America. The grim figures below show the metrics of the disaster, but they cannot begin to describe the tragedy and trauma exacted.

This article is the story of the soldiers, sailors, airmen, and marines of Joint Task Force-Bravo (JTF-B), who participated in Operation Fuerte Apoyo (Strong Support). Together they survived the ravages of the hurricane firsthand and then exerted Herculean effort to save human lives and mitigate suffering. It is a story about a team, thrown together, that displayed the brotherhood of the Americas working together in a time of tragedy. Even though most of Central America was affected by the storm, the small country of Honduras—about the size of Tennessee and located in the center of the region—withstood the majority of the wrath of Hurricane Mitch. Therefore this article focuses on relief efforts in Honduras.

Hurricane Mitch Statistics	
Persons killed and/or missing	More than 10,000
Persons displaced	Nearly 3,000,000
Bridges destroyed	More than 300
Roads damaged	More than 1,000 kilometers
Estimated damage	$10 billion

Joint Task Force-Bravo

The Coronel Enrique Soto Cano Air Base, located approximately 75 kilometers north of the capital city of Tegucigalpa in the Department of Comayagua, is home to the Honduran Air Force Academy and JTF-B. Assigned to the U.S. Southern Command (USSOUTHCOM), JTF-B was organized in 1983 to assist in the national policy of deterring Nicaraguan aggression in Central America and to provide command and control over U.S. military units deployed to the joint



operations area. Over time, the organization and the mission have changed. Under the revised 1996 Operations Order Central Champs, JTF-B now conducts and supports the USSOUTHCOM commander's directed joint, combined, and interagency operations in the joint operations area to enhance regional cooperative security. Inclusive in this mission as the commander's strategic "gateway" to Central America (Belize, Guatemala, El Salvador, Nicaragua, Costa Rica, and Honduras) are these specific tasks:

- Maintain a C5-capable airfield.
- Conduct humanitarian assistance and disaster relief exercises (medical readiness training and engineering).
- Support Joint Chiefs of Staff joint/combined exercise training.
- Act as executive agent for humanitarian demining as well as counternarcotic operations.

When installations close and the United States' presence in Panama is removed (by 31 December 1999), JTF-B will be the only forward-deployed force in Central and South America. The organizational structure is the result of a downsizing operation to an eventual zero presence in Honduras, but it halted at 499 personnel in 1996. The resulting organization is "a mile wide and a foot deep."

The Hurricane

On 22 October 1998, the JTF-B commander alerted Situation Assessment Team-Alpha (SAT-A) to travel to the Pacific coast of Costa Rico to survey flood damage caused by heavy rains. Meanwhile, base weather personnel began watching Tropical Storm Mitch in the Caribbean off the northern coast of Honduras. National Weather Service predictions showed the storm increasing in strength and its path heading straight for Belize. Because the majority of Belize is at or near sea level, the JTF-B commander became concerned that a storm of this size would cause catastrophic damage. He put the team on hold and redirected its attention to Belize. The determination was made not to send the team's helicopters to Belize until after the storm had passed to avoid damage to the helicopters and the potential of the team becoming stranded.

As the hurricane began to develop and damage the northern coast of Honduras, the commander directed that a second situation assessment team (SAT–B) be formed to move north and perform surveys. The team left for the coast on 28 October. They made it as far as La Mesa International Airfield near San Pedro Sula, Honduras' second largest city, before the hurricane forced them to stop. The team was trapped in San Pedro Sula as the hurricane passed south of them and damaged roads, cutting them off from Soto Cano Air Base. Meanwhile the National Weather Service continued to predict the hurricane track into Belize. As the storm traveled across Honduras, it dumped as much as 84 inches of rain in five days.

Assessments continued throughout the first weeks after the storm, conducted mainly from UH-60 Black Hawk helicopters because floodwaters had not receded and roads were generally impassable. After the search-and-rescue effort trailed off, the JTF-B commander dedicated one helicopter daily to the engineers to conduct assessments and reconnaissance. This was critical to rapidly gain a picture of the overall situation; it greatly assisted in early determination for critical areas for engineer response.

Seabees from NMCB 7 finish a culvert/gabion crossing over the Rio Hombre at Rio Hondo.

Rehabilitation

After Soto Cano was out of danger and there was some idea of the extent of the damage to the country's infrastructure, the JTF-B's Directorate of Engineering began to coordinate with the Honduran government and SOUTHCOM for the U.S. forces' response. Tegucigalpa, located on the convergence of three major rivers, was hit particularly hard by the hurricane. Its downtown area was wiped out, and most government office buildings were flooded and lost all facilities, automation, and equipment. This situation, along with the death of the mayor in a helicopter crash, left the government in disarray. The JTF-B commander issued planning guidance and directed the JTF engineers to develop a methodology and concept to rehabilitate the country. The JTF-B commander's planning guidance for engineer operations was clear and simple: *Conduct initial rehabilitation of critical lines of communication and critical infrastructure nodes to conduct humanitarian assistance efforts and provide an initial assessment of critical municipal and national infrastructure.*

The concept of rehabilitation was to link the northern and southern ports with the capital along Centro Americano Carretera 5 (CA-5) to form the backbone of a relief supply route. Then branch roads linking the departmental capitals with the backbone route would be repaired. This plan was initially briefed to the commander of the Honduran Armed Forces and the Secretaria de Obras Publicas y Transporte (Secretary of Public Works and Transportation—or SECOPT). The plan was well received but not for the reasons on which it was predicated. The plan was based on connecting the national capitals with departmental capitals—or along political lines. It just so happened that this plan also supported the economic necessity and lines of communication for getting agricultural harvests (primarily coffee and fruit) to international markets. This event began a direct relationship between the SECOPT and the JTF-B engineers.

During the immediate aftermath of the hurricane, the Honduran government went through several reorganizations to maximize their limited resources and streamline command and control. SECOPT was reorganized and became the Secretaria de Obras Publicas, Transporte y Vivienda (Secretary of Public Works, Transportation, and Housing—or SOPTRAVI). JTF-B engineers coordinated through the Military Group–Honduras to meet with SOPTRAVI at its temporary office in a parking garage at the Tocontin Airport in Tegucigalpa. A complex process began to prioritize and assign projects based on the resources available and the capabilities of the various countries that volunteered to help. JTF-B engineers spent many hours negotiating with SOPTRAVI on where to employ U.S. engineers, the specific projects, and standards of construction.

While coordinating with SOPTRAVI, SOUTHCOM was also preparing an engineer force package to support engineer operations in the four countries affected by the hurricane: Honduras, Nicaragua, Guatemala, and El Salvador. Based on the assessment already forwarded to SOUTHCOM from the joint operations area and the approved concept of operations, SOUTHCOM engineers devised a package that consisted of an engineer command and control headquarters, vertical and horizontal construction capabilities, and a bridging unit for each country. U.S. Atlantic Command was tasked to provide the units and further tasked the service components. The following units were selected to fill the requirements for Honduras:

- 22nd Naval Construction Regiment (FWD) as the overall engineer task force headquarters.
- Naval Mobile Construction Battalion 7 (NMCB 7) and the U.S. Army 68th Engineer Company (Combat Support Equipment [CSE)] as the vertical and horizontal construction capabilities.
- U.S. Marine Corps Combat Service Support Detachment 68 (CSSD 68) as the bridging asset.

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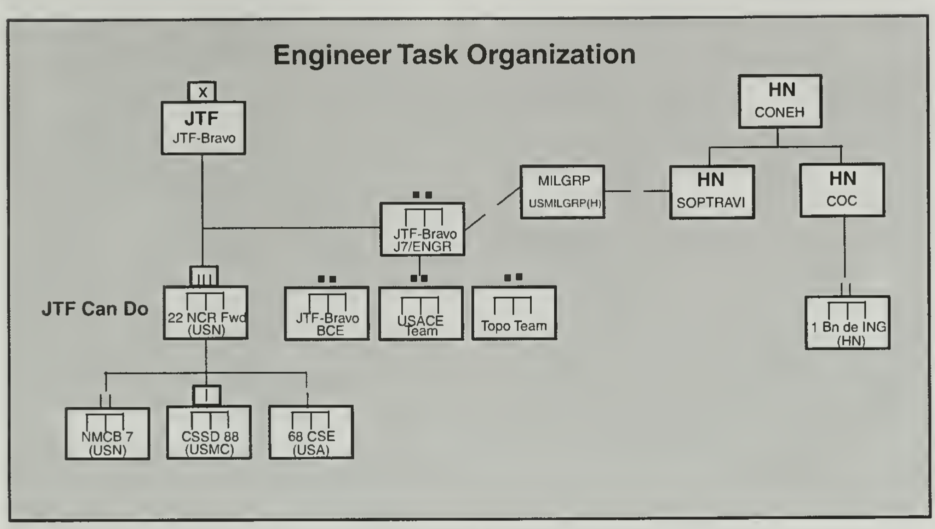
The figure to the right shows the initial engineer task organization and line of coordination.



Engineer Projects

The final list of projects for JTF- B engineers includes four low-water crossings, five bridges, 135 kilometers of road work, and the repair of municipal utilities. The first priority was to link the coffee-producing regions west of Tegucigalpa to the capital and on to the ports. Two culvert crossing sites were constructed by NMCB 7 at Rio Hondo and Talanga. Not only was it important to reconnect this road for relief operations, it was also a major economic line of communication for the coffee harvest, which was ready for market. If the roads could not be opened, it would further compound the effects of the hurricane on the Honduran economy. Rio Hondo is where Honduran Route 15 (HN-15) crosses Rio del Hombre. This highway connects areas north, northwest, and west of the capital to the rest of the country. South of Talanga at a pueblo named San Juan de Flores, was a secondary route connecting Carratera 6 (CA-6) with HN-15 between Ojo de Agua and Talanga. This route helped relieve traffic off CA-6 while the bridge at Ojo de Agua was being shipped and installed. Constructed by NMCB 7, it consisted of a culvert crossing along the Rio Grande de Choluteca.

The third crossing was an ACROW bridge installed by CSSD 68 and the Honduran Primer Batallon de Ingenieria on CA-6 over the Rio Grande de Choluteca, which connected the coffee-growing region to the west of the capital. It was of major economic importance to get surviving crops to market.

The next priority was to reconnect the north coast highway from Puerto Castilla to Puerto Cortes. CA-13 runs along the northern coast of Honduras and connects an important fruit-growing region with the ports. Fruit exports are a major source of foreign income for Honduras. Three major cuts along this route were at Rio Bonito, Rio Perla, and Rio Congrejal. Unseasonable rains in December and January seriously hampered construction at these sites. In several instances, ongoing work was washed away by high, rapid currents. Rio Congrejal, which was constructed by NMCB 7, and Rio Perla, which was constructed by the 68th Engineer Company (CSE), were culvert crossings. Rio Bonito was a culvert causeway built by the 68th, but the CSSD 68 and Honduran engineers installed its 50-meter bridge.

Several important and difficult projects assigned throughout Honduras focused on commercial routes but were too difficult for the Honduran government to accomplish with its assets. The engineers of JTF-B assessed the projects and erected two bridges at Tegucigalpa and Ilama, repaired 35 kilometers of road in and around Morazan, and opened the port at Puerto Castilla.

In downtown Tegucigalpa, few bridges span the Rio Grande de Choluteca, which splits the city. The Molina Bridge was lost during the hurricane. A 50-meter, two-lane panel bridge originally was prescribed for the site, but it was not possible to locate four suitable points on which to rest a simple span bridge. Ultimately, CSSD 68 installed a 74-meter, two-lane, Class-40, triple-double ACROW bridge on footers specially designed to accept the weight of the bridge on existing structures.

The Ilama Bridge crosses the Rio Ulua and links the northern and southern parts of the country east of Lago de Yahoa. The only other route requires a five-hour detour. The available panel bridging could only span 74 meters in a single span, and the river current and limitations of the military engineers prohibited construction of an intermediate support. Therefore, the U.S. Army Corps of Engineers (USACE) located a suitable site upriver to construct a causeway and prepare a site for the bridge. A hydrologist and a civil engineer from USACE designed and supervised the 68th Engineer Company (CSE) in constructing the causeway and abutments and the CSSD 68 in constructing the bridge.

The road from Morazan to Yoro connects the Upper Valle de Aguan with the Valle de Sula (two important agricultural regions). Meandering up a narrow valley, a 7-kilometer section of the road was almost completely wiped out by raging currents. NMCB 7 and 68th Engineer Company (CSE) worked with local contractors at several sites along the road to make it passable to commercial traffic. These patches and crossings were very expedient and were not expected to last through the next rainy season. NMCB 7 also worked in and around Morazan on local mountain roads to clear mudslides and re-establish drainage. Despite their remote

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Soldiers from the 68th CSE Company emplace a culvert at the village of Morazan.

location and the devastation of that region, the local people were always willing to help the Seabees and Army engineers in the area.

The main port facility for international shipment of fruit produced in the Valle de Aguan is Puerto Castilla. The port was heavily hit by high winds and sea surges. Two vessels were sunk on the docks: a Honduran Navy PT boat and a fishing trawler. These ships reduced the already limited dock capacity by half and made it necessary to load fruit shipments over the docks by hand. The reduced dock capability significantly decreased the throughput of commercial products and inhibited deployment of National Guard engineers en route to the area. U.S. Army divers from the 544th Engineer Team (Dive) of TF-10 (10th Transportation Battalion) worked for several weeks to salvage the vessels. They cut the PT boat into pieces and raised each piece separately with cranes. Using the same method, they raised the trawler in one piece, towed it to open water, and sank it. (See article on page 9.)

Lessons Learned

The lessons learned from this joint engineering operation were innumerable and many were not captured. Junior leaders—who faced and overcame difficulties in leadership, logistics, and engineering—learned most from this operation. Some of the major lessons learned at the joint level follow.

Engineer Command and Control

In an operation requiring significant engineer effort, the engineer command and control headquarters must be able to control all engineers in theater, design construction projects, perform construction management and quality assurance, and manage construction materials. The JTF-B Directorate of Engineering expected the 22nd Naval Construction Regiment (FWD) to be like a U.S. Army engineer construction group and command all engineers and their support elements and manage all construction in the joint operations area. Plans were made accordingly, and difficult projects were selected all through the Valle de Sula, western departments of Honduras, and the north coast. However, the 22nd only expected to build a 1,000-man base camp and perform repairs in and around Soto Cano. The unit selected the NMCB 7 headquarters as its "forward" command element and provided some augmentation. This arrangement overtaxed the 22nd's capability to command and control widely dispersed engineer missions. In particular, Seabees lack sufficient organic long-range communications to cover platoon-sized elements dispersed over a wide area. They are accustomed to receiving a mission then task organizing and cross attaching troops between companies to tailor a package for the mission.

Before deploying, the NMCB 7 and the air detachment commanders asked for specific missions and a definite engineer end state. JTF-B could not provide the 22nd with the information they needed because the situation was unclear at that time: assessments were incomplete, the Directorate of Engineering was still working with SOPTRAVI to define the U.S. role, and there were no designs for projects. Therefore the entire NMCB was deployed.

Because JTF-B expected to put the U.S. Marine Corps bridge company under the 22nd Naval Construction Regiment (FWD) for command, control, and support, they anticipated a unit of 80-90 marines. However, the SOUTHCOM operations order told units to plan to be self-sufficient when they arrived. Therefore the Marine Corps put together a package consisting of the bridge company; a reverse osmosis water-purification unit; and transportation, maintenance, communications, and other service support personnel. A total of 240 marines from the 2nd Landing Support Battalion at Camp Lejune became the Combat Service Support Detachment 68.

The Marine Corps' decision was fortuitous because the Seabees were recalled in mid-January and the CSSD 68 element was needed to command and control the remaining engineers—the Marine Corps Bridge Company and the 68th Engineer Company (CSE). Because it was a service support unit, CSSD 68 had no staff engineer section. The unit was augmented with an engineer major and captain from the JTF-B staff and a design team from USACE. The design team included a hydrologist, a structural engineer, a civil engineer, and a site manager.

Class IV Management

Engineers must be able to requisition, manage, transport, and handle their Class IV bills of materials, which are essential to joint engineer mission accomplishment. Without positive control, many missions would have failed, not been completed on time, or not started at all. During this deployment, engineers were in total control of ordering, acquisition, transportation, handling, and accounting for Class IV supplies. The Seabees' Class IV was shipped directly from their unit in Gulfport, Mississippi, to Soto Cano. All other Class IV was procured through purchase requests and contracts prepared by engineers. The Seabees and marines either used organic assets to line-haul the materials or contracted the line-haul from a local vendor. Either way the engineers had positive control over the bills of materials.

Naval Facilities (NAVFAC) and USACE Roles

These engineers played a critical role in providing assessments, designs, and project management and were key to the success of this operation. USACE responded early to requests for assessments but redeployed when the assessments were completed. Later, NAVFAC engineers, who augmented the 22nd Naval Construction Regiment (FWD), completed initial designs for expedient crossings and performed several assessments of public facilities. They delivered expeditionary designs based on minimal data. Their job was made difficult because little or no valid hydrologic data was available. When the NAVFAC engineers redeployed with the Seabees in mid-January, a design team was needed to assist in redesigning structures that had failed due to unseasonably heavy rains. A second USACE team that had the right skills was assigned and took ownership of the projects.

Working With the Host Nation

No two nations are the same. Even in Central America, *each country has its own customs, culture, history, and sensitivities.* To be successful with any of them, *country leaders must feel that they own the plan—because in reality they do.* The best JTF-B's Directorate of Engineering could do was articulate the capabilities of U.S. forces and recommend how they could best be used. There were many players in the relief effort: nongovernmental organizations, private volunteer organizations, and civilian and military personnel. *It is useful to know the big picture to determine where U.S. forces fit best. In disaster situations, especially where the government has been directly affected, it is important to be patient as they recover from the disaster. It is important to make clear what U.S. forces are willing and able to do and make sure they deliver. Always take minutes of meetings and record agreements, then translate them and provide the host nation government a copy. This confirms expectations and avoids misunderstandings.* In many cases, the Hondurans thought the U.S. temporary fixes would be permanent fixes. It was necessary to send written notification through the U.S. Embassy to the Honduran government to reiterate the expediency of the repairs and warn that they might not last through the rainy season.

The country's military groups and the civil-military operations office (JTF-B J5) played an invaluable role in coordinating engineer operations with the Honduran government, the local populace, and civilian contractors. All coordination with Honduras and other Central American countries was done through the military groups. They acted as an intermediary and helped convey the JTF-B story to the host nation and vice versa. They, along with the civil-military operations, coordinated with the Honduran military to provide security and engineers. Civil-military operations teams were assigned to every forward operating base and helped garner local support and labor for projects. The teams dealt directly with the local SOPTRAVI contractors on site to synchronize and support each project.

Panel Bridging

In this disaster, the Bailey bridge seemed to be a panacea for all bridging problems. The JTF-B engineer section was inundated with questions about this bridge from all sectors—government, civilian, military, foreign, and U.S. When word was put out that the Bailey bridge manual was available on the U.S. Army Engineer Center's home page, everyone became an instant Bailey bridge expert. There was a general misunderstanding of the capabilities and limitations of the bridge and exactly what it could do. Another misunderstanding was that commercially available panel bridges are of the same quality, the parts are interchangeable, and a single-single (single-width, single-story) bridge will fit any gap. In fact, each brand of bridging is different, and bridges must be specially designed for each gap. The Honduran government estimated that they had 700 meters of gap to bridge, so they ordered 700 meters of single-single panel bridging. However, river channel conditions made it impractical to build intermediate supports, so multistory, multiwidth bridges were designed. The original 700 meters of bridging was only enough to construct three bridges, and then only after ordering additional parts.

In the initial planning immediately after the hurricane, SOUTHCOM engineers researched the availability of Bailey bridging from war stocks. They found that most of the bridges were in poor condition and not ready for shipment. Thus, all the bridges emplaced by U.S. forces were commercially purchased panel bridges. Although their concept was similar to the Bailey bridge, marine engineers required a technical representative from the manufacturer to assist in the installation. In all instances, the panel bridges were placed adjacent to or as a detour away from the damaged bridge site. This allowed traffic to continue so the host

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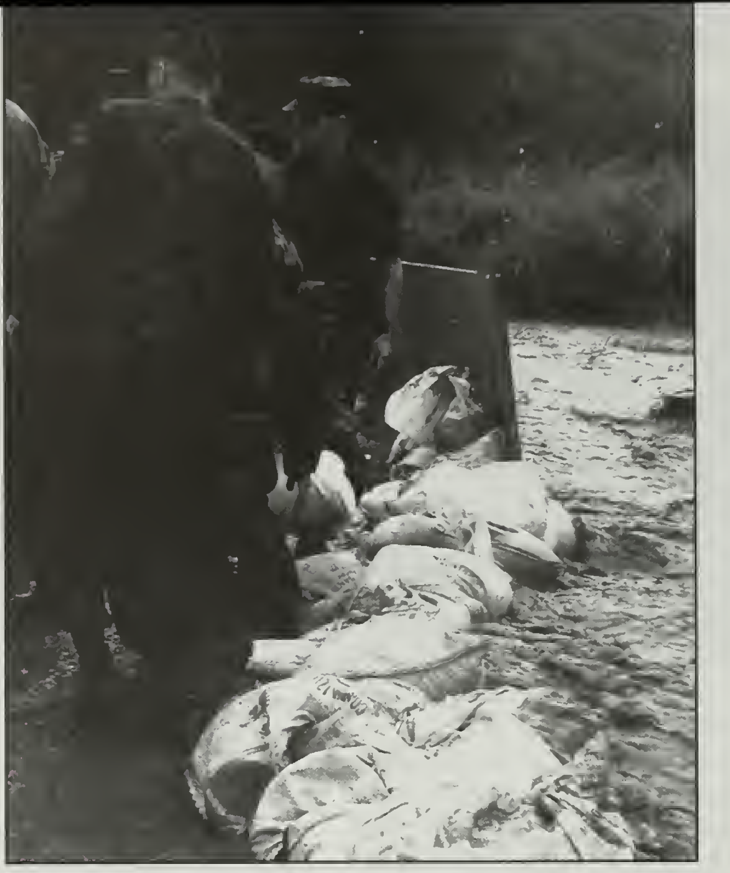

Soldiers and airmen construct a flood levee on Rio Conquigue.

nation could reconstruct permanent bridges. *The recommended solution is to keep a list of commercially available panel bridge points of contact, then custom order bridges to fit each site.*

Topographic Support

Early in the operation, the Directorate of Engineering determined a need for topographic surveys and terrain analyses. The topography of the country had altered due to significant land slides and river course changes. New topographic data was needed to determine the extent of the changes, to correct existing maps, and to determine watershed changes for hydrologic design.

When JTF-B was initially asked for their augmentation requirements, the Directorate of Engineering asked for a topographic survey detachment and a terrain analysis team. After several iterations of military occupational skills and grade changes, the commander of the 30th Engineer Battalion (Topographic) (Army) was consulted. Once he heard the requirements, he recommended and deployed a composite team of surveyors and terrain analysts. The surveyors surveyed bridge and crossing sites and river channels for JTF-B and assisted USACE and U.S. Geological Survey teams in surveying serious landslides. The surveyors also trained Hondurans to use newly acquired state-of-the-art topographic survey equipment.

The terrain analysts did not fare as well. An analysis of imagery before and after Hurricane Mitch could show areas of damage and changes in topography and watersheds. Even though U.S. Army Space Command offered to get the most recent post-Mitch data, baud rates and a disrupted postal system prevented getting the data to the terrain team. They did, however, produce several useful products for both JTF-B and the Honduran government. A landslide in the heart of the capital blocked the Rio de Choluteca and backed water into the city. The resulting topographic survey and terrain analysis allowed geotechnical experts to determine the extent of the slide, predict further slippage, and design remedial solutions. *The lesson learned is to keep data on the joint operations area as current as possible because the means to get new data may not be available or timely.*

Lastly, in dealing with civilians and other governmental agencies, the use of military grids is not widely accepted outside tactical units. However, when geolocating sites, using latitude and longitude was universally understood.

Real-World Training

This episode in Honduras was tragic to the people, the economy, and the country. But it provided an excellent training ground for all service engineers. No amount of training can prepare a unit, organization, or country for a disaster of the magnitude of Hurricane Mitch. Every unit that participated increased their training readiness. Young leaders were placed in remote locations and were required to act on their own with minimal guidance. Faced with issues of force protection, caring for their troops, and constantly dealing with local officials and contractors, they gained real-world experience rarely available at combat training centers. The engineering problems that the officers and NCOs encountered could not be taught in the classroom. Each problem required a unique solution, and in all cases decisions were made on the spot.

All parties involved made mistakes, but the service engineers demonstrated an incredible amount of ingenuity, flexibility, and teamwork. Jointness at the individual level was never an issue. Soldiers, sailors, airmen, and marines all saw the destruction of the countries and worked together to ensure that projects were completed.

Lieutenant Colonel Nicholson is the Director of Engineering, JTF-Bravo, Soto Cano Air Base, Honduras. Previous command assignments include: A/13th Engineer Battalion, 42nd Engineer Company, Berlin Brigade and Operations Wing, Australian School of Military Engineering. LTC Nicholson is a graduate of CGSC and is enrolled in the Army War College Distance Education.

U.S. ARMY DIVERS IN OPERATIONS OTHER THAN WAR

By Captain Daniel Coffey

The U.S. Army is performing more and more operations other than war (OOTW). These missions provide opportunities for the United States to help other countries in times of need and bolster its foreign policy at the same time. The U.S. Army Diving Company recently participated in Operation Fuerte Apoyo (Strong Support)—providing disaster relief in Central America after Hurricane Mitch. One mission during the deployment was to salvage two sunken vessels that blocked much of a pier that is vital to the Honduran economy. The mission is one example of how U.S. Army divers can help during OOTW. Some of the lessons we learned may be useful to units involved in other operations.

Diving Units

The U.S. Army "Deep Sea" diving community is comprised of six separately deployable detachments. The main body of five detachments is based at Fort Eustis, Virginia, and structured as the U.S. Army Diving Company "Provisional." The remaining detachment is in Hawaii. The U.S. Army divers' mission is to provide engineer diving support to major commands, task forces, government agencies, and sister services throughout the world. Their capabilities encompass everything from underwater construction/repair and salvage operations to inland waterway mobility and countermobility operations. More specifically, diving units conduct the following operations:

- Ship salvage
- Underwater obstacle reduction and removal
- Hydrographic surveys
- Channel and harbor inspections
- Pipeline placement and inspections
- Ship husbandry (maintenance and inspections)
- Water bottom sampling
- Lock and dam inspections and repair
- Bridge inspections and repair
- Port construction and rehabilitation
- Civilian contract quality control
- Personnel, vehicles, and equipment search, salvage, and recovery
- Near- and far-shore reconnaissance in support of river-crossing operations
- Emergency medical recompression treatment

Deployment

On 25 November 1998, the 7th Transportation Group was notified to organize Task Force 10 to participate in Hurricane Mitch relief operations. The task force included line haul units, cargo watercraft, and cargo transfer units. Its primary mission was to transport equipment, supplies, and personnel throughout Central America. The 544th Diving Detachment was also organized under Task Force 10 and was instructed to deploy with the assets needed to accomplish all possible diving missions.

The Mission

Task Force 10 deployed to Central America on 9 December. The first 45 days were spent performing ship husbandry and hydrographic surveys. About mid-January, we were given the mission to survey two sunken Honduran navy vessels in Puerto Castilla, Honduras, for possible salvage. One was a patrol (PT) boat, and the other was a fishing trawler seized during drug raids. These vessels, each more than 100 feet long, were blocking about half of the pier where much of the country's fruit shipments were loaded. After surveying the area, we estimated that we could accomplish the mission in about 21 days once we were on site.

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A crane lifts the bow of the PT boat onto the pier at Puerto Castilla.

Logistically, a great deal of coordination was required. The first challenge was to find a suitable place to land our vessel to off-load equipment. We needed a ramp and would need U.S. Army engineer support from units already in country to help build it. However, moving heavy equipment through Honduras was virtually impossible because of bridge and road conditions.

We found an area that looked as if it had been used years ago as a landing ramp. Construction materials were scattered, but with proper equipment, we could reconstruct it. The port had heavy equipment on site that we could use, and the head of the Port Authority arranged for personnel to help us. We completed the ramp in one day. *This drove home the lesson to use resources that are on hand whenever possible.*

The main body of divers arrived on 24 January, and we began working the following day. We split the mission into two phases—one to recover the PT boat and the other to remove the fishing trawler.

The PT boat was too badly damaged to use again. However, the vessel represented one-fifth of the Honduran navy's fleet, so they needed to salvage the engines and weapons to use on other vessels. Our plan was to use two 40-foot cranes with cable slings to lift the boat until water and the ship's weight caused it to break into sections. Then we could lift the pieces out with the cranes.

During our first lift attempt, about 30-35 feet of the bow ripped off and was removed. We tried to make the vessel more accessible by pulling it closer to shore, but the vessel was too heavy. We had to cut the remainder of the boat into pieces by hand, which was a very time-intensive process.

Removing the PT boat took the crew almost 21 days, but the second crew worked concurrently to take out the fishing boat. The vessel was in 40 feet of water with a large hole in its port side. We planned to patch the hole underwater, then raise the boat to the surface with the cranes. It was a difficult and dangerous process. We rigged the vessel for lifting and tried to raise it, but it would not budge. Every option we tried was unsuccessful, so we ordered two 150-ton cranes from Fort Eustis. A week after these cranes arrived, we removed the vessel. After pumping water out (see photo on page 9), we towed the vessel to deeper water and sank it.

Never underestimate the time or resources it will take to complete a mission. Our original estimate of 21 days was based on a best-case scenario—that we could recover both vessels with the two 40-ton cranes in the area. But underestimating the equipment caused us to require about 49 days to complete the mission.

Over and over, we saw how important it is to use assets on hand. We used the host nation's military as well as U.S. assets in the area. The Honduran navy had a base a mile from the work site, and their divers were eager to help. Their knowledge of the vessels and expertise were extremely useful during the recovery effort. When crowds became a problem, they stationed an armed guard on-site.

U.S. National Guard units in the area provided bulldozer winch support during one phase of the operation. At times the U.S. National Guard, the Honduran military, and the 544th Diving Detachment worked together to remove the sunken vessels.

We learned from government and military representatives on site that our operation had the attention of the country's top naval general and the Honduran president. The mission also warranted an on-site visit by General Reimer, Chief of Staff of the U.S. Army. *Never underestimate the importance of your OOTW mission. Something routine in the United States may be monumental in underdeveloped countries.*

Operating in a foreign country presents unique challenges, and one of them is the language barrier. *In OOTW, it is imperative that you communicate well with the host nation. To do this, someone in the unit must speak the host nation's language fluently.*

A Valuable Asset

The U.S Army has one of the most unique and least-known assets in the military—deep-sea divers. Engineer diving units have capabilities that facilitate the successful completion of numerous missions, including OOTW. Operations other than war present tremendous opportunities to work with and help countries in need. Although these operations involve unique and challenging problems, the lessons learned and the impact the work has on the country make it an incredibly rewarding experience.

The Army needs more divers! If you are a specialist (E4) or below and are interested in an exciting career change, contact the Army Liaison Office at the Naval Diving and Salvage Training Center, Panama City, Florida. The telephone number is (850) 235-5261; the web site is *http://members.aol.com/alondstc/diverapp.htm.*

Captain Coffey is attending the Engineer Officer Advanced Course before reporting for duty in Hawaii. Previous assignments include the 544th Engineer Team (Dive), Fort Eustis, Virginia.

BRIDGE RECONSTRUCTION:

POLISH ENGINEERS PROVIDE ASSISTANCE AFTER 1,000-YEAR FLOOD

By Colonel Zenon Zamiar, Major Tomasz Ciszewski, and Lieutenant Colonel Zbigniew Kamyk

The following article by staff at the Tadeusz Kosciuszko Military Academy, Wroclaw, Poland, describes the unexpected 1,000-year flood that inundated southern Poland in July 1997. The authors detail the flood's ruthless destruction of thousands of kilometers (km) of roads and numerous bridges that existed in the watershed. Polish engineers reacted quickly and lent military assistance to the immobilized countryside. The authors describe the engineers' experiences during reconstruction of the area's bridge infrastructure and explain the technical and organizational challenges they faced as well as the solutions employed. Lessons learned concerning the capabilities of small engineer bridging units are emphasized.

The 1,000-Year Flood

Prolonged and abundant rainfalls in July 1997 caused freshets within the southern part of Poland. Two flood waves that overflowed riverbeds and damaged or destroyed many bridges and road sections were especially severe. Based on the range of this disaster, it has been named the "Millennium Flood."

Destruction of Roads and Bridges

From the beginning of the flood to the end of July, the following main and local roads and bridges were excluded from traffic:

- 480 bridges, including 219 main road bridges and 261 local road bridges.
- 791 road sections, including 232 main road sections and 559 local road sections, with a total length of 3,172 km.

The greatest damage occurred in mountainous regions where roads are adjacent to rivers and streams. Many small bridges were built over rivers that run along main, local, and private roads to connect the roads to households. This parallel system of roads and rivers was the basic cause of the enormous devastation and damage to roads and bridges. The great mass and speed of the flood waves caused most of the destruction. Design flow values previously provided as permissible for bridges within Kotlina Klodzka, a mountainous valley in southwest Poland, were exceeded many times. Additionally, debris carried by flowing water plugged bridge clearances and increased stream speeds (velocities). As a result, the destroying force of water was intensified and caused stream bottoms to erode, especially at bridge supports.

In order to evaluate the kinds and causes of damage to bridges, engineers first must analyze the mechanisms that caused the damage. During the first phase of flood-destructive operations on bridge objects, we noted undermining and settlement of the bridge supports, and many of them finally collapsed (Figure 1). When that happened, the bridge spans broke, fell, and were destroyed. Fallen bridges and their support elements then barricaded the water beds, leading to increased stream speeds and the creation of new main water streams. The next result was undermining of stream banks and bridge access embankments, which caused the crowns on roads located along rivers to be washed away. We noted that

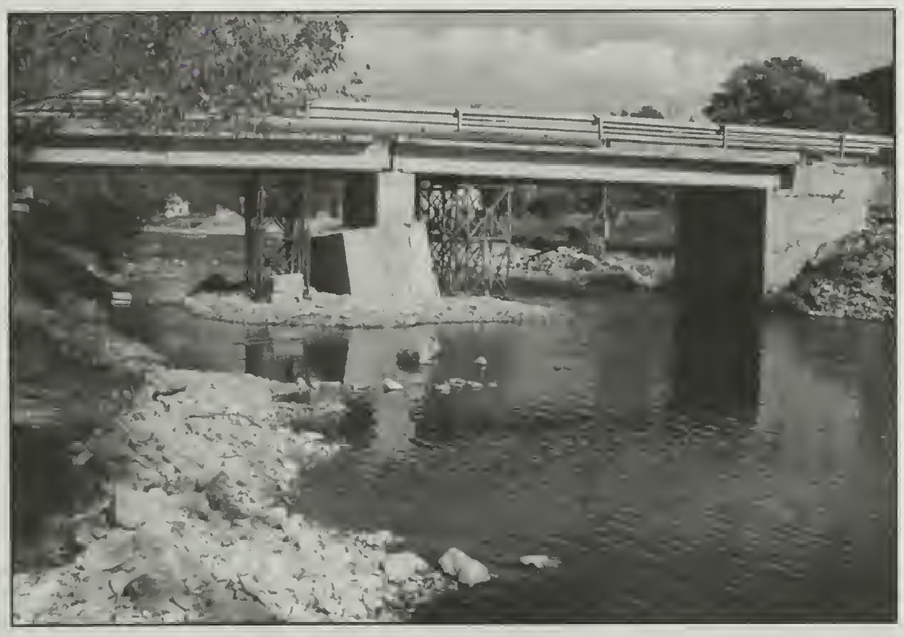

Figure 1. Lifted spans after the bridge broke due to undermining of its pillar. Note the significant settlement (approximately 1 meter) of the pillar and its dislocation (Radochów town - Baila Ladecka River).

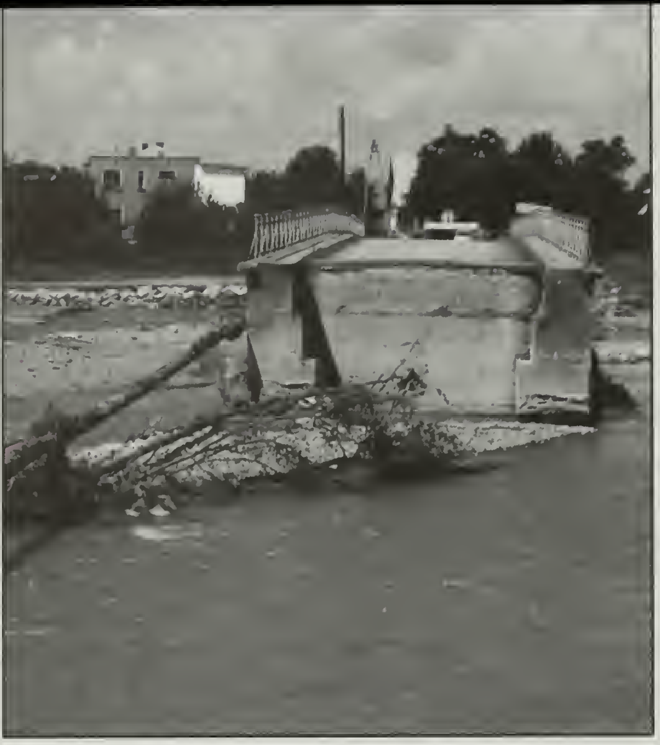

Figure 2. A washed out embankment behind a bridgehead. A 60-meter section of the access road was destroyed (Bystrzyca Dolna town - Bystrzyca River).

undermining of bridge supports caused the destruction of load-carrying members of all types of bridges except footbridges. Often, when bridge members withstood the water pressure, their access embankments were destroyed (Figure 2). At some locations new water beds were created (as at Radochów and Wilkanów). In many places, water mass created new, temporary riverbeds, which caused significant damage to areas along their routes. Bridge supports located in meanders of rivers and locations where bridges limited the natural stream width were especially exposed to undermining.

One example illustrating the elemental force of water is the 30-meter steel framework construction footbridge in Radochów. This footbridge was broken and moved a distance of 500 meters by floodwater. Water carried it over a broken bridge that lay in its way. *Destruction mechanism analyses show that proper protection of bridge supports against undermining is the most effective method of preventing damage. Bridge-support durability should be considered the main factor in designing and building bridges, because it determines the bridges' resistance to the destructive force of flood waves.*

Preparation for Eliminating Flood Consequences

For the temporary reconstruction of flood-damaged objects, the following units, specially trained for that purpose, were involved: military engineering units, military communication units, and civilian road- and bridge-building companies.

On 9 July 1997, as soon as falling water levels allowed, engineers started to identify and assess the damage and eliminate consequences of the flood. Due to persistently high water levels in rivers, impassable road sections, and the loss of communication with field units, it was difficult to assess the damage to roads and bridge structures.

During the first stage, immediately after the flood crest passed, the army assigned priority to the quick restoration of traffic along main transport routes. This was done by temporary reconstruction of the structures. By cooperating closely with civilian road services and municipal authorities, the army started to open passages in disrupted links. During the first stage, damaged bridges along main transport routes and national and local road sections were selected for repair.

Following the governor's request for assistance in repairing bridges and roads, a mobile team of military experts on transportation went to the zones affected by the disaster. Their task was to identify and evaluate the damage and indicate the technical and technological/organizational variants of their reconstruction. The goals of their reconnaissance were to determine the feasibility of using local materials, determine the military technical measures required, and assess field conditions (such as the condition of access roads and the possibility of deploying troops to the area of reconstruction).

The bridge reconstruction method chosen was largely determined by the following criteria:

- Degree of destruction.
- Significance and transportation requirements of the line the bridge was built on.
- Length of time the bridge will be in use.
- Available materials and structures.
- Capabilities of the engineering troops.
- Length of time assigned for reconstruction.

The basic requirements for bridges to be reconstructed included the following: limiting outline height (minimum 4.5 meters), roadway width (minimum 4.2 meters), and horizontal outline width where track spans were used (minimum 3.4 meters). Engineer experts adjusted the time of use of temporary bridges to match the characteristics of the road traffic, the obstacle type, and the anticipated time needed to replace temporary bridge structures with permanent structures.

The bridge reconstruction method selected was determined by the working requirements (people, materials, machinery, and engineering devices). Due to organizational conditions, engineers divided the entire work cycle into preparation and execution periods.

Preparation work included the following tasks:

- Engineer reconnaissance of bridge construction sites, places to prepare the materials and bridge structures, and supply paths.

- Removal of damaged spans and supports from the river bottom.
- Preparation and transport of structures and materials to the building site.
- Preparation of access roads and supply paths for materials and equipment.
- Preparation of building sites.
- Development of the work-mechanization measures and other devices needed to reconstruct the bridges.
- Preparation of design documentation.

The principal actions needed to execute temporary bridge reconstruction included the following tasks:

- Staking out the bridge axis.
- Constructing indirect and bank supports.
- Assembling the span structure and placing it on the supports.
- Constructing bridge entrances.
- Commissioning bridge use to local authorities and the road administration.

After determining the scope of the damage, engineers refined the concept of using military resources to eliminate flood consequences on the road network.

Bridge Reconstruction

To accelerate the pace of bridge reconstruction and quickly restore traffic continuity along main routes, engineers adapted the use of folding bridges (similar to Bailey bridges) and assault bridge structures for civilian traffic. The use of pontoon bridges was not possible in this mountainous area due to low water levels after the flood crests.

The DMS-65 folding road bridge, in the form of a free-supported beam, was the principal structure used to reconstruct destroyed bridge structures. Its theoretical span depended on land conditions. Essential components of the DMS-65 are spatial and flat elements of the main girder, transverse beams, the platform slab, and bolts to link particular segments of the structure.

Technical Characteristics of a DMS-65 Bridge

This bridge is meant for quick and multiple construction or reconstruction of destroyed high-water bridges. Using its components, it is possible to build single- or multiple-span bridges, with spans ranging from 3.0 to 45.0 m, and the change modulus 3.0 m in length. Due to the narrow width of water courses in Kotlina Klodzka, engineers reconstructed the bridges using single-span structures. A two-span continuous system was used only at Pilce (Figure 3).

The width of the roadway placed below or above is 4.2 meters, with a widening to 6.2 meters. The static system of the spans is assumed to be free-supported or continuous. The maximum span length under a load of 600 kilo-Newton (kN) (67.446 U.S. tons) is 39 meters for free-supported spans, 39 meters for outer continuous spans, and 45 meters for middle continuous spans. The maximum span length under a load of 800 kN (89.928 U.S. tons) is 33 meters for free-supported spans, 33 meters for outer continuous spans, and 39 meters for middle continuous spans. Bridge supports may be permanent (concrete), temporary, or floating.

Within three days, the army built a DMS-65 collapsible temporary bridge next to the destroyed bridge at Roztoki (Miedzylesie Commune, Figure 4, page 14). The road the bridge is built on is an important transport route from Warsaw to Prague and Vienna. Numerous local businesses and thousands of motorists use this road every day. Similar structures were built at Gajnik and Goworów.

The structure at Roztoki has the character of a temporary bridge but will function until a permanent bridge is built. A permanent bridge is planned at Roztoki as a gift for flood victims. Local societies will use the bridges at Gajnik and Goworów for the next few years. The bridge at Gajnik has steel pipe abutments and a retaining wall. This solution should make the supports resistant to future washout and make it prospectively possible for a future permanent bridge to be supported on them. *To make the roadway level with the bridge formation line for smooth passage, it was necessary to lower the bridge bearings below the surface level and apply an intermediate slab in the form of a 3-meter entry span.*

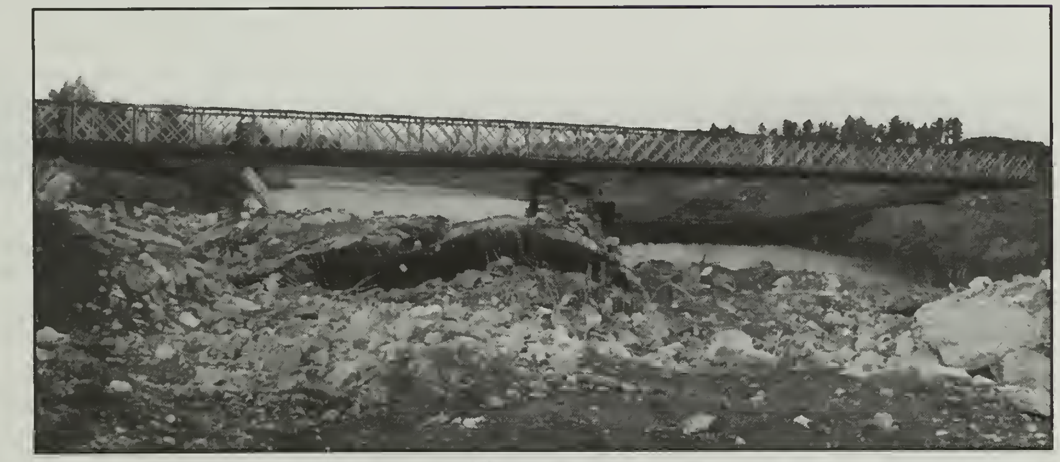

Figure 3. A bypass bridge made of DMS-65 structure elements with a continuous beam of 33 meters + 33 meters in length and access spans of 3 meters in length. The remaining parts of a destroyed bridge of 59 meters in length (Pilce town on the Nysa Klodzka River) are shown in the foreground.

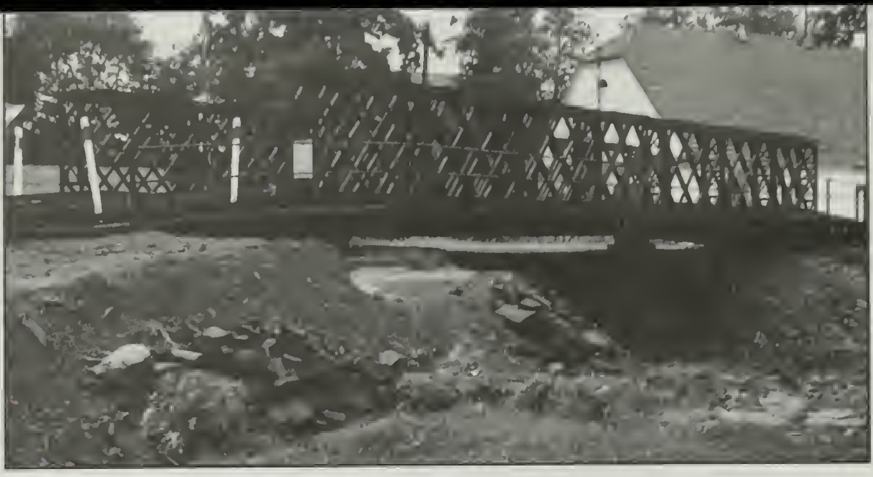

Figure 4. Free-supported spans in a DMS-65 structure in the basic arrangement. It has a 21-meter span with 6-meter entry spans stretching Lc = 7 meters (Roztoki - Miedzylesie Commune on the Nysa Klodzka River).

Technical Operating Characteristics of BLG and SMT-1 Assault Bridges

BLG and SMT-1 bridge spans are track structures that are laid directly on an obstacle (see table below). They are principally used for single-span bridge construction. These bridges allow pedestrians and wheeled and tracked vehicles to pass the obstacle. The structures should be supported on strong subsoil and protected from washout or slide. The length of support on reinforced banks is at least 0.50 m.

To increase vehicle and pedestrian safety, engineers increased the limited width and free space left between the tracks and installed handrails. An unquestionable advantage of these adaptive solutions is that both assembly and disassembly can be performed quite quickly (Figures 5 and 6, page 15). These adaptations made it possible to perform the repair quickly and to restore the span's military functions.

Engineers used a BLG span discarded by the army to build a bridge at Kletno. They built up the intertrack space using steel plates that were welded to track edges and supported on steel crossbars that were welded to track structures. In addition, the engineers made channel-bar steel curbs and angle-bar handrails (Figure 5c, page 15). While the reduced width of the span (3.20 m) fails to meet the requirements for tracked bridges, the ability to build the bridge quickly was a decisive factor in using this method.

In other places, temporary reconstruction was performed or low-water bridges were built in cooperation with local authorities using local materials.

Conclusions

The following conclusions are based on experience gained during the 1997 flood:

- The order in which destroyed roads and bridges were to be reconstructed depended on how quickly the water level fell and how significant the bridges and roads were for transportation. The priority was for temporary (immediate) reconstruction using local materials and military resources.
- Where lasting damage was revealed but did not yet threaten bridge stability, officials allowed traffic to cross the structures under certain limitations until comprehensive reconstruction was performed.
- Where bridge structures had been totally destroyed by the flood and required comprehensive reconstruction, engineers recommended a detailed analysis and assessment of the disaster causes. Conclusions drawn from the analyses and assessments were used to help avoid repeating the same or similar mistakes when reconstructing or building bridges.
- Where bridges were destroyed, engineers made road detours for the shortest access to dwellings and business places. Engineers also constructed temporary bridges made of wood or used collapsible steel structures stored in so-called "transport reserves" of the State. These temporary measures should work until permanent bridges are built.
- Assault and folding bridges may have wide applications outside of the military community, especially when

Technical Operating Characteristics of BLG and SMT-1 Spans

Parameters	Armored Vehicle-Launched Bridge (BLG-67)	Wheeled Vehicle Assault Bridge (SMT-1)
Width of land obstacles to be passed	Up to 19 m	6 to 10 m
Number of directions	One-way traffic	One-way traffic
Load-bearing capacity	150 kN (16.86 t) for wheeled vehicles and 500 kN (56.21 t) for tracked vehicles	110 kN (12.36 t) for wheeled vehicles
Span length	20 m	10.5 m
Span width	3.25 m (BLG-67M2 - 3.43 m)	3.30 m
Number of tracks	2	2
Track width	1.15 m (BLG-67M2 - 1.24 m)	1.20 m
Distance between tracks	0.95 m	0.90 m
Span weight	60 kN (6.74 t) (BLG-67M2 - 70 kN or 7.87 t)	29 kN (3.26 t)

BLG-67M2=New model.
kN = kilo-Newton. 1 kip = 4.448 kN; 1 U.S. ton = 8.896 kN.

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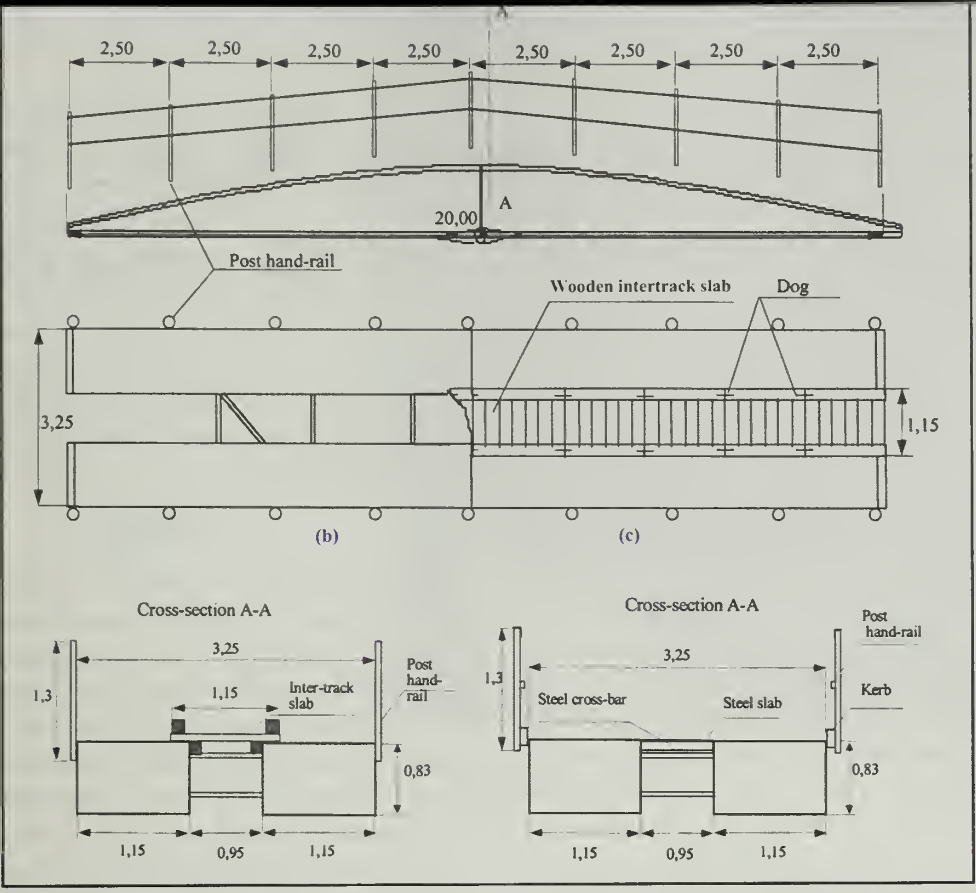

Figure 5. A scheme for building up a BLG span: (a) and (b) use wooden intertrack slabs, and (c) uses steel intertrack slabs.

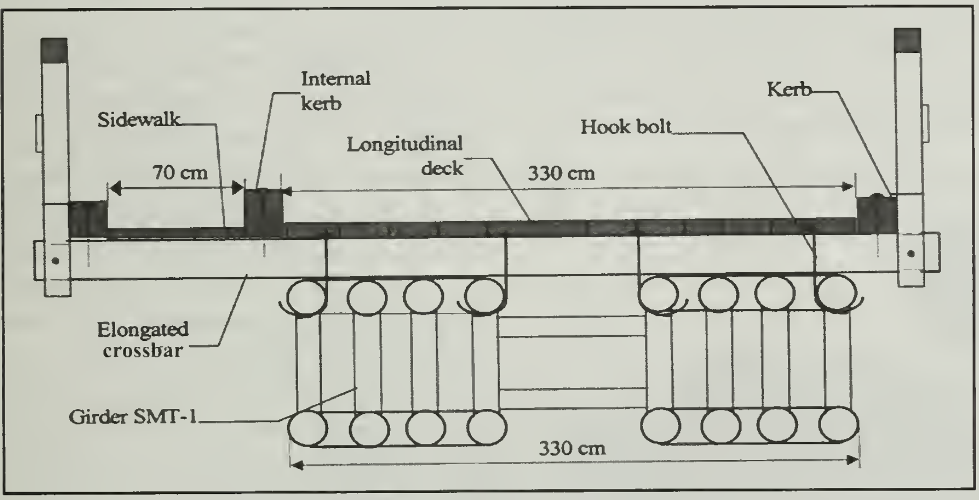

Figure 6. Cross section of an SMT bridge span. The bridge is built longitudinally with a wooden deck on crossbars.

repairing damage from disasters or accidents, and have enormous benefits to society.

Engineers generally should design new bridges with longer spans than those used in the past. They should properly protect riverbanks and bridge supports against washout (undermining). Additionally, civilian and military authorities should prepare detailed plans for their cooperation when working to prevent flood damage and when cleaning up after a flood or other disaster.

Colonel Zamiar is the Dean of Military Engineering Faculty at the Thaddeus Kosciusko Military Academy, Wroclaw, Poland. During the 1997 flood, he served as the Chief of the Anti-Flood Combined Command.

Major Ciszewski is head of the Road Construction Division of the Military Engineering Faculty, Thaddeus Kosciusko Military Academy, Wroclaw, Poland. During the 1997 flood, he served as a planning officer for the Anti-Flood Combined Command.

Lieutenant Colonel Kamyk is head of the Bridges and Crossing Division of the Military Engineer Faculty, Thaddeus Kosciusko Military Academy, Wroclaw, Poland. He served as a planning officer for the Anti-Flood Combined Command during the 1997 flood.

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Joint Engineers Build a Temporary Parking Apron

By Lieutenant Kevin J. Bartoe, USN

The ability to transform a field of thick vegetation into a solid helicopter parking apron is one thing that makes military engineers so valuable. Joint engineer forces make the impossible possible by completing engineering missions while under fire or in peacetime. With the continuing resource challenges we face, joint engineering operations are demonstrating their value by making the best use of all resources.

Naval Mobile Construction Battalion 4 (NMCB 4) was tasked with a deployment for training to construct a 290,000-square-foot expeditionary parking apron on the U.S. Army K-16 Airfield in Seoul, Korea. The apron would be built using AM-2 matting. Originally designed as a rapid runway repair tool, the 2-foot by 12-foot aluminum-magnesium panels have preformed grooves that lock together and form a staggered grid pattern. The ends are locked in place with a thin locking bar, which is also aluminum. The apron at K-16 Airfield would provide temporary parking for 16 UH-60 Black Hawk helicopters while the existing asphalt apron was replaced with a new concrete apron. Funding for the project was to be provided by the Republic of Korea Funded Construction program. The customer for the parking apron was 1/52 Aviation Battalion, 17th Aviation Brigade.

Photo by JO1 J.C. Musser

The 7.1-acre, 11,900-piece apron is put together like a gigantic puzzle by hand, crowbar and sledgehammer.

Planning

The construction tasking called for clearing and grubbing a 7.1-acre site adjacent to the existing 9,900-foot runway. The K-16 Airfield is controlled and operated by the Republic of Korea Air Force, which required thorough access control procedures and reporting on the project's progress. After clearing the site, a 6- to 8-inch lift of fill material from an adjacent in situ fill pile would be placed, compacted, and graded to finish elevation. Then, 11,900 sheets of AM-2 matting would be placed on the 204-foot by 1,360-foot area. Access to the existing airfield taxiway would be maintained by constructing a culvert system across a 10-foot-deep, 25-foot-wide drainage ditch. Additionally, an access road for fuel support vehicles would be constructed.

For the project's horizontal tasking, NMCB 4 assembled a 24-person detail of equipment operators, construction mechanics, an engineering aide, and others. Twenty marines from 9th Engineering Support Battalion, Okinawa, Japan, provided additional labor and AM-2 technical expertise.

Obtaining equipment for the project was an open issue as the Seabee advance party deployed on 22 October 1998. Funds to draw equipment from theater war reserve were still in the approval process. To get the project started, four pieces of equipment were moved from the Seabee camp in Pohang, Korea, to K-16 Airfield. The Seabee advance party worked with the limited equipment fleet for 30 days and accomplished 90 percent of the clearing and subbase rough grade.

Funding for the project was ultimately provided from the Eighth U.S. Army commanding general's "flex" funds. These funds enabled the unit to draw on Air Force war reserves of civil engineer support equipment at Suwon Air Base. Maintained by the U.S. Air Force 607th Material Maintenance Squadron Detachment 2, the fleet consists of more than 400 pieces of equipment ranging from flight-line support gear to troop movers.

Executing the Project

With the entire vehicle fleet on site by 20 November, it was time to move full speed ahead on the project. The mixed-service equipment suite included two bulldozers, two motor graders, three front-end loaders, two vibratory rollers, five dump trucks, one wheeled excavator, and troop support vehicles for the 44 personnel assigned to the task.

The clearing and grubbing operations concluded after removing 7,000 cubic yards of spoil and vegetation. The clay-rich subbase material was rough graded to a 1-percent slope and compacted. Then, 5,200 cubic yards—more than 800 truckloads—of select fill material were placed. Conveniently, the fill site was less than one-quarter mile from the project, which made haul times short. By 27 November, the rough grading was 90 percent complete and the fill placement was 30 percent complete. The marines arrived on 28-29 November and began placing AM-2 matting on 1 December.

Photo by JO1 J.C. Musser

A crew of NMCB 4 Seabees prepares to build a roadway to the airstrip over an existing gully.

Matting, Matting, and More Matting…

The placement system for AM-2 matting is designed to be simple and straightforward. However, each panel weighs 144 pounds and each pallet of 20 panels weighs almost 3,000 pounds. Placing the matting is highly labor intensive and requires a hardworking crew to successfully complete the task.

Marines from the 9th Engineering Support Battalion began with a goal of placing 10,000 square feet of matting each day. After two days on the job, they averaged 20,000 square feet of matting per day and peaked at 31,416 square feet during one 9-hour day. As Seabee equipment operators placed the fill material and completed related site work, they shifted crews to the matting task as well. The entire 285,600-square-foot main parking apron was completed by 16 December, just 14 working days after work began.

Clean Up and Wrap Up

The final work elements of the project were wrapped up by 21 December. This included constructing a culvert crossing for the 10-foot-deep drainage ditch; finishing the fuel access road, which included a soil stabilization operation; cleaning the matting; and final grading the fill site. Follow-on work for the Army Directorate of Public Works included painting parking and taxi lines and installing aircraft mooring points.

Seabee equipment operators and construction mechanics washed and inspected the equipment and returned it to Suwon Air Base. The total cost of repairing 15 pieces of construction equipment was less than $15,000, one-half of the original $30,000 estimate. Total equipment operating time was 1,200 hours and 1,500 miles worth of troop training.

Working Together

This project provided high-quality training for everyone involved. Navy Seabees received construction training similar to what they would receive in a contingency environment. Marine Corps engineers practiced AM-2 matting installation, which is one of their major requirements in support of marine air/ground task force operations. Air Force and Army personnel demonstrated outstanding support and contributed vital resources to the project. Under the leadership of U.S. Forces, Korea, engineers worked together in a joint environment and accomplished the task on schedule. From junior Seabees or marines up to the officer in charge and the staff at U.S. Forces, Korea, it was clear that each of the four services plays a vital role in the Korean theater. Engineers must be prepared to work together in peacetime taskings as well as in contingency operations.

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The Engineer Bradley Fighting Vehicle

By Chester A. Kojro

This is the third in a series of articles concerning a possible replacement for the M113A3 armored personnel carrier (APC) for mechanized combat engineers. The November 1998 issue of Engineer presented preliminary observations from the field. In March 1999, Engineer published a white paper stating why engineers need the Bradley Fighting Vehicle (BFV). This article describes the U.S. Army Engineer School's efforts to field the Engineer Bradley Fighting Vehicle (E-BFV) to replace the APC.

Engineers support the maneuver brigade commander's scheme of maneuver as part of the brigade combat team in the close fight. They also fight as infantry, and mechanized engineers fight as mechanized infantry. Engineers and infantry have always been linked: they have marched, ridden, and fought together with the same equipment. In World War II, both used armored halftracks; and during the Cold War, both used APCs. In the future, both will use the yet-to-be-defined Future Infantry Vehicle. It is only now that engineers are equipped with a distinctly less-capable vehicle than the infantry soldiers they accompany and support.

The Problem

The M113A3 APC is an excellent armored carrier and will remain a fully capable "battlefield taxi" throughout the foreseeable future. However, it does not belong in the forward edge of the combat team. The APC cannot defend itself on today's mechanized battlefield, much less on future battlefields to be faced by the Force XXI Conservative Heavy Division and Army After Next. Engineers cannot keep up with the tank and mechanized battalions they support. Engineers are readily identifiable on the battlefield and, because they lack a defensive capability, are often singled out for destruction by enemy forces.

Like tanks, mechanized Infantry Fighting Vehicles have modern, lethal cannons and missiles with full-solution fire control; stabilized thermal sights; and an armor-protected, shoot-on-the-move capability in all weather and visibility. They also have survivability enhancements that protect the crew after the hull is penetrated. Meanwhile, accompanying engineers in their APCs must expose themselves to fire to manhandle a single, flex-mounted .50-caliber machine gun. They have nothing but their eyes for fire control and cannot expect to penetrate and defeat enemy armored fighting vehicles even if they are lucky enough to score a few hits.

Engineers carry a lot of equipment and materiel—mines, explosive demolitions, barrier materials, and special tools—as well as specialized obstacle-breaching systems, such as mine-clearing line charges (MICLICs). The current "solution" is for engineer squad APCs to pull cargo trailers, which creates more problems. The added weight overtaxes engines and drive trains, and maintenance problems multiply. APCs are less agile with trailers attached because the trailers may jackknife and flip, especially when traveling cross-country. In addition, trailers block the APC's rear ramp, making it difficult to exit a damaged or burning vehicle.

The Solution

The solution to these problems is the Engineer Bradley Fighting Vehicle. Table 1, page 19, shows major milestones in the effort to field such a vehicle.

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Table 1

Engineer Bradley Fighting Vehicle History	
Mid-1980s	Under the Armored Family of Vehicles (AFV) program, engineers pursued the Sapper Vehicle (SV), a variant of the yet-to-be-defined Infantry Future Fighting Vehicle. Under this program, all vehicles were to have a turreted cannon. The SV was to have a dozer blade, backhoe, hydraulic auger, and hydraulic power tools.
1988	Many of the tools and systems were incompatible and were trimmed from the SV. The turret was replaced with a commander's weapon station. The backhoe was removed because it would tie the vehicle to the work site rather than to an overwatching position. The AFV program was downsized, reorganized, renamed, and finally disappeared due to lack of funding, but the conceptual SV remained.
Late 1980s	The Canadian Special Engineer Vehicle (SEV)—an M113 with a dozer blade, hydraulic auger, and hydraulic tools—was considered. The blade had a flotation backing that allowed it to float and serve as a trim vane, so the vehicle could swim like a conventional APC. As with the SV, hydraulics to power the blade and auger reduced interior volume needed for the engineer squad's equipment, so interest in the SEV never developed.
1994	The Engineer School developed a mission need statement for an Engineer Squad Armored Carrier. The focus was on the need to maneuver (and survive) alongside Infantry Fighting Vehicles and tanks and the need for a large cargo capacity. Analyses pointed to a stretched APC or a turretless Bradley. In the stretched M113A3, the hull was cut and an extra 3-foot section inserted. The APC also had an extra (sixth) road wheel and an uprated engine. The turretless Bradley allowed extra space, but the turret ring's gaping hole had to be replaced with a new top deck with a commander's weapon station and crew/cargo hatches. Hull wiring that previously ran through the turret slip rings required rerouting, and new positions for radios and controls had to be developed.
December 1995	The stretched APC was the preferred solution of the two and was so briefed to the Army Vice Chief of Staff. But it was still a defenseless vehicle, even though the trailer was eliminated.
1997	MG Gill, Engineer School Commandant, directed that an operational concept be prepared for the Bradley Engineer Squad Vehicle, including an assessment of DTLOMS.
July 1997	The operational concept was submitted to TRADOC.
January 1998	The operational concept was endorsed by TRADOC, but implementation was deferred pending a more detailed assessment of resource impacts. According to the concept, BFVs would replace all engineer APCs in divisional battalions of active component (AC) divisions and Army National Guard (ARNG) enhanced brigades and in engineer companies of Armored Cavalry Regiments (ACR). Engineer corps mechanized battalions and ARNG divisional battalions were not included because they were to be reorganized under the Army's Force XXI effort. The total requirement was estimated to be 1,005 vehicles. Eliminating squad trailers would result in a need for additional cargo vehicles and drivers.
Summer 1998	No decision was made at HQDA, and attention shifted to the Army's Heavy Force Modernization Plan. Engineer School representatives to the working group for the plan raised the E-BFV issue, but a decision was deferred because the requirement was unfunded.
October 1998	MG Flowers, Engineer School commandant, directed that a white paper be written stating why engineers need the E-BFV (see *Engineer*, March 1999).
December 1998	TRADOC directed the Bradley proponent, the Infantry School, to prepare a recommendation on the feasibility of an E-BFV.
May 1999	TRADOC approved the infantry/engineer assessment and the E-BFV operational concept, which has changed considerably since the 1997 concept.

Advantages

Engineers mounted in E-BFVs would gain the following:

- Survivability through lethality (defensive fire from the tube-launched, optically-tracked, wire-guided missile [TOW] and 25-millimeter cannon).
- Improved situational awareness (armor-protected turret with enhanced optics and forward-looking infrared).
- A common signature (to prevent the enemy from specifically targeting engineers and to reduce fratricide)
- Improved cross-country mobility (for example, crossing gaps).
- Logistics and maintenance commonality with the brigade combat team.

Considerations

Some of the logic concerning which Bradley Fighting Vehicle model is needed follows:

The original M2A0 model is obsolete, and existing M2A0s are unsuitable. Practically everything on them has been upgraded or modernized, so there is little maintenance commonality with later models. Their age and mileage would make them a readiness nightmare.

No M2A1s remain, since they have all been upgraded to M2A2 or higher.

During Operation Desert Storm, needed improvements to the M2A2 were identified, which resulted in the M2A2 ODS (Operation Desert Storm). Improvements include an eye-safe laser range finder, a Global Positioning System/digital compass, missile countermeasures, enhanced driver's thermal viewer, internal restowage, and mounting provisions for Battlefield Command Identification System. The M2A2 ODS is the current frontline infantry vehicle. When upgraded with a "digital applique," it will be compatible with Force XXI digital requirements.

As AC infantry units receive the M2A2 ODS, their M2A2s are being cascaded to ARNG infantry battalions. Diverting these vehicles to AC engineer battalions would derail ARNG modernization, to which the Army is fully committed.

The M2A2 is suitable for today's engineer, but it needs upgrades to be compatible with the digitized applique required under Force XXI. This would create a sort of M2A2 "hybrid" that would be "almost an ODS" but not quite. It would cost about the same initially and less in the long run to select the M2A2 ODS configuration for engineers.

Under Conservative Heavy Division redesign, tank and infantry battalions are smaller by one line company each. Excess M2A2 and M2A2 ODS models are being turned in and will be rebuilt to the yet-to-be-fielded M2A3 configuration. The M2A3 will be fully digitized and will be interoperable with the M2A2 ODS (w/applique). Only a limited number of M2A3s will be fielded, and none are available for engineers. Retaining the division's excess M2A2 and M2A2 ODS models for engineer use is not acceptable since it would derail the M2A3 fielding schedule. (One engineer battalion equivalent—about 30 BFVs—had been retained at 4th Infantry Division at Fort Hood, Texas, but this was a temporary exception.)

Given all of these considerations and constraints, the agreed-upon plan is to use excess M2A0 BFVs and upgrade them to the M2A2 ODS configuration. Except for removing the internal TOW racks, the E-BFV will be identical to the infantry M2A2 ODS. Once the digital applique is fielded, the E-BFV will be operationally compatible with the digitized brigade combat team of Force XXI.

Table 2 shows the breakdown for the 668 Bradleys required for conversion under the Heavy Force Modernization Plan.

Table 2

Bradleys Required for E-BFV Conversion

Type of Unit	Number of Units	Quantity Per Unit	Total Requirement
AC Divisional Engineer Battalions	18	29	522
AC Armored Cavalry Regiment Engineer Company	1	13	13
Pre-positioned Battalion Sets	3	29	87
National Training Center	1	20	20
Engineer School	1	22	22
Infantry School	1	4	4
Total			668

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Table 3

DTLOMS Impacts of the Engineer Bradley Fighting Vehicle	
Doctrine	Field and training manuals will be revised to reflect added engineer capability. These include FM 5-10, *Combat Engineer Platoon*; FM 5-71-2, *Armored Task Force Engineer Combat Operations*; FM 5-71-3, *Brigade Engineer Combat Operations (Armored)*; FM 5-71-100, *Division Engineer Combat Operations*; MTP 5-335 series, *Engineer Topographic Units*; FM 71-1, *Tank and Mechanized Infantry Company Team*; FM 71-2, *The Tank and Mechanized Infantry Battalion Task Force*; and 71-3, *The Armored and Mechanized Infantry Brigade*. Tactics, techniques, and procedures (TTPs) also will be revised.
Training	The Engineer School will adjust training for 12B10 One-Station Unit Training, 12B30 Basic Noncommissioned Officer Course, Career Management Field 12 Advanced Noncommissioned Officer Course, Engineer Officer Basic Course, and Engineer Officer Advanced Course. Engineer NETT will be raised and resourced.
Leader Development	Engineer master gunners and engineer Bradley Leader Course graduates will be assigned an additional skill identifier and tracked accordingly.
Organization	M113A3 APCs will be replaced one-for-one. There will be no change to engineer platoon, company, and battalion structure, and no personnel or vehicles will be added to the engineer battalion. Forward support maintenance will need six additional mechanics per engineer battalion (18 mechanics per division with three engineer battalions).
Materiel	The E-BFV is essentially identical to the Infantry's M2A2 ODS Bradley, with only minor changes to the internal stowage configuration.
Soldier	Engineer units will be more capable. They will be more survivable through improved lethality, situational awareness, and armored protection.

Impacts

Due to other changes associated with Conservative Heavy Division redesign (independent of the E-BFV issue), acquiring the E-BFV will not significantly impact equipment and personnel at the battalion level. All positions will be satisfied through redistribution of available personnel, and no added vehicles are needed. At the division level, there is an increase of six mechanics per engineer battalion or 18 per division. So the six AC divisions require an additional 108 mechanics.

Training will be impacted based on the increase in firepower (25-millimeter cannon and TOW) and sophistication of the fighting vehicle overall. New equipment training teams (NETT) will provide initial training. Engineers will conduct semiannual gunnery using common tables I through VIII and engineer-specific tables XI and XII. Engineers will also conduct one combined arms live-fire exercise and two field training exercises annually. All training for the TOW will be conducted using simulators and training devices rather than live missiles. Each engineer battalion will have one set of training aids, devices, simulators, and simulations, which consists of Conduct-of-Fire Trainer, Precision Gunnery System, and Through-Sight Video.

Engineer master gunners will be trained at the U.S. Army Infantry Center's Bradley Master Gunner Course. Engineer leaders initially will be trained at the Infantry Center's Bradley Leader Course until an engineer-specific course is taught at the Maneuver Support Center at Fort Leonard Wood, Missouri. Course scheduling will depend on the E-BFV fielding schedule. During initial low-rate fielding (less than 60 per year), training will continue at Fort Benning, Georgia. Engineer-specific training will begin at Fort Leonard Wood as fielding expands to two or more battalions (60 vehicles) per year.

Table 3 shows how transitioning to the E-BFV will impact DTLOMS.

The Result

While specific milestones have not been determined at this time, Engineer School personnel are hopeful that E-BFV fielding may begin as soon as 2004. With this vehicle, engineers will shoot, move, and communicate as fully capable members of the brigade combat team of the Force XXI Conservative Heavy Division design. They will be in line with the infantry for further transitions to follow-on combat systems such as the Future Infantry Vehicle and Future Combat Vehicle of the next two decades. With comparable equipment, engineers will finally return to their position alongside the infantry as they enter the close fight at the tip of the brigade combat team.

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SapperNET:
Creating an Engineer-Relevant Common Picture

By Captain Timothy T. Sellers and Major Dionysios Anninos

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The Chief of Staff of the Army's *Vision 2010* instructs us to "leverage technology" and "foster innovation and experimentation." That's exactly what the 3rd Infantry Division engineers accomplished with the creation of SapperNET, a fully automated, web-based tactical reporting system. Using Warfighter preparatory exercises as a test bed, we experimented with databases and Hypertext Markup Language (HTML) interfaces to establish a system that was a combat multiplier during 3rd Infantry Division's Warfighter exercise.

The more comprehensive and complex solutions offered by Force XXI take time to fully test, and there is no way to predict when these solutions will be implemented at the division level. By leveraging existing technology, the Engineer Brigade developed an interim solution for its information needs today. SapperNET uses existing hardware, an open architecture, and commercial off-the-shelf software to provide timely, accurate data for creating the engineer-relevant common picture (ERCP).

SapperNET Evolution

We began with the central idea of creating the ERCP. An elusive problem, it not only involved creating the information product but also distributing it across the battlefield. Early ideas focused more on the product and less on its dissemination. The idea of a terrain summary that looked much like the intelligence summary (INTSUM) went a long way toward providing a common picture, but it lacked the level of detail required to ensure relevance to the end user. Further, the terrain summary would be created without dynamic input from the individuals most knowledgeable of the terrain. At best, it would provide a text-based summary with a simple cartoon to illustrate broad mobility concepts.

Maneuver Control System/Phoenix (MCS/P) offered another method of establishing a common picture. A UNIX-based program running on high-end Sun workstations, it could assimilate information from other MCS/P terminals and autoplot that information on a digitized map. Its downfall, however, was the requirement for high-cost hardware and proprietary software that could only communicate with other MCS/P systems. Further, it required extensive contractor support and was highly inflexible. In the end, these issues proved to be insurmountable in creating a system that would work today.

We had an idea for using a central database to synthesize information and ease distribution so that information could be shared in real time. An HTML interface would allow dynamic input from end users, while giving nonengineer customers the ability to tailor information to their individual needs. Using commercial off-the-shelf software and existing automation assets, we created a fully automated information solution for division engineers. This solution provided the detail, relevance, and flexibility lacking in previous systems. In short, by using a common laptop with open-architecture software, SapperNET provided an interim information solution for Force XXI objectives.

Lessons Learned

Early versions of SapperNET were primitive. They amounted to ad hoc use of the tactical local area network (TACLAN) to help disseminate engineer information reports from the engineer tactical command post (ETAC). Far from being interactive, information was reported to ETAC through FM or mobile subscriber equipment (MSE) voice, typed into report data tables using Microsoft Excel, and then saved in HTML format. The HTML files were transferred to a web server located at the engineer main command post (EMAIN). Battle staff personnel at each command post could then use the "refresh" feature of their web browser to see the most recent information. The process was extremely labor intensive for the web master, who also served as the battle captain in the ETAC.

Despite its initial drawbacks, we could see the inherent potential in using web technology to share our engineer information. The dividends SapperNET provided in the form of reduced FM voice traffic and timely, accurate information proved the validity of our concept. All engineer elements, to include the 10th, 11th, and 317th Engineer Battalions and the Engineer Brigade distributed command posts—ETAC, EMAIN, and engineer rear command post (EREAR)—enjoyed the same ERCP. In addition, the 36th Engineer Group, a Corps asset, could share in the benefits of SapperNET's products.

We recognized, however, that SapperNET must evolve to overcome its drawbacks. Our goal was to develop a reporting and information distribution system that would:

- Support quick and easy reporting.
- Support one-time submission of information.
- Permit easy updating of reports without resubmission.
- Reduce FM and MSE voice transmissions.
- Provide instantaneous ERCP data to all engineer command posts.
- Provide an easy planning tool for nonengineer customers to facilitate battlespace mobility.

It was evident that we needed a self-sufficient, dynamic web page to achieve these objectives.

Incremental Software Development

We began by defining how and what relevant information should be shared across the division. In a conscious effort to not recreate our standard report formats, we based the database structure on existing field standard operating procedure reports. If we stuck to this format, we could make the existing system more efficient without adding more reporting requirements for subordinate units. In short, this would put us in a favorable "fallback" position should we have to revert to the old way of doing business.

The next challenge was to design the interface. Users needed the capability to view and edit information. More specifically, we wanted to provide the capability to tailor information to individual unit's needs. Using the Internet, we found a shareware program called *BaseRunner.* A common gateway interface application, BaseRunner allows users to input data through HTML forms using drop-down menus. It automatically places a date/time stamp on input and allows formatting of output into data tables.

BaseRunner, however, only reads from "flat" database tables. In other words, it limits the user's ability to query SapperNET's database and thus tailor this information. It also forced us to store the same information in multiple data tables. We tested this version of SapperNET during Command Post Exercise (CPX) 99-02 in December 1998. It resulted in an even greater decrease in FM and MSE voice traffic. SapperNET received more than 200 obstacle reports and more than 50 breach lane reports throughout the four-day exercise. ERCP was now shared instantaneously across the battlefield. The division embraced our efforts, and the potential for a web-based information system was evident.

The next step was to provide users the capability to query SapperNET's database. Again, we searched the Internet and found a program called *ODBIC*, which draws its data directly from any open database, such as Microsoft Access, Microsoft Excel, or Oracle. It also supports the use of Structured Query Language. This capability allows users to control what information is extracted from the database and allowed us to efficiently store information in the SapperNET database.

This version of SapperNET, using both ODBIC and BaseRunner, was tested during CPX 99-03 in January 1999. By then, radio-telephone operators were spending more time on the computer than on the radio. All engineer operational and logistical reports were sent on SapperNET. Commanders were free to use the FM without first clearing the net.

The final version of SapperNET—running completely on ODBIC—was tested during the 3rd Infantry Division Warfighter Exercise in February 1999 with amazing results. During the five-day exercise, 488 obstacles, more than 50 breach lanes, and 136 main supply route waypoints were reported (Figure 1). More than 170 users accessed SapperNET with more than 25,000 hits on the web page (Figure 2). In one instance, SapperNET provided maneuver commanders with timely information that directly contributed to executing 15 Air Volcano situational obstacles and a division-level counterattack into the enemies' flanks. This effort resulted in the

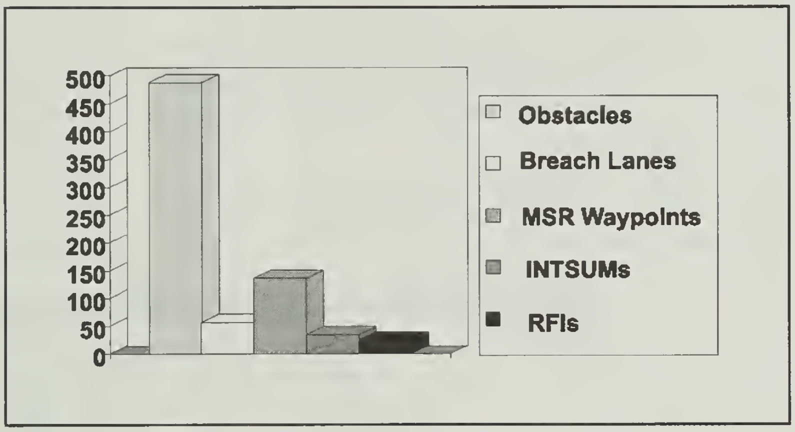

Figure 1. Number and Kinds of Reports

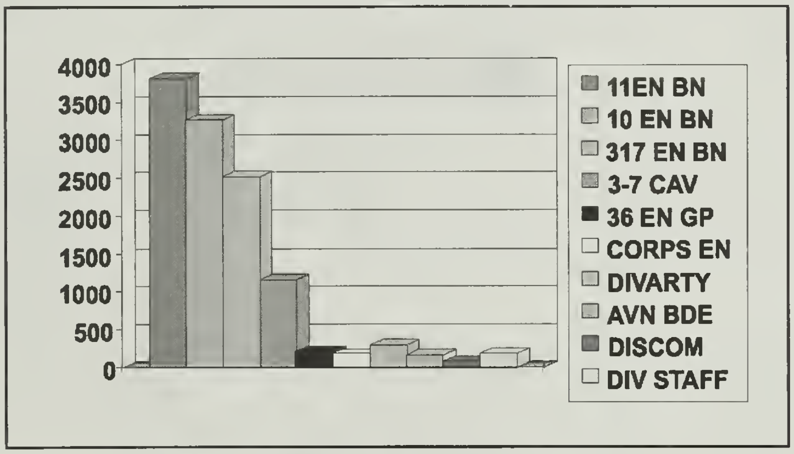

Figure 2. Web Page Hits

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division destroying three regiments while preventing any penetration into the division's rear area.

Throughout the exercise, SapperNET achieved an instantaneous, accurate ERCP, while greatly reducing traffic on FM and MSE command nets. SapperNET provided an obstacle search tool for our nonengineer customers. Using this tool, a planner can specify an area and SapperNET will report all obstacles and obstacle breaches in the area. This valuable tool eliminated the need for nonengineer command posts to track all obstacles in the division area. The result was significantly fewer incidents of fratricide and elimination of the need for engineer officer liaisons at these headquarters. In short, the entire engineer community and the division possessed the ERCP. Possession was not limited by who did or did not have Advanced Warfighting Experiment Appliqué.

SapperNET Features

SapperNET's web interface uses forms and tables to gather user inputs and format the output. Output tables show obstacle data, breach lanes, main supply routes, combat power, unit locations, countermobility, and survivability status. In addition to tabular data, it also provides a request-for-information (RFI) board, a terrain analysis page, and an engineer intelligence summary page.

PowerPoint slides in HTML format are used to brief division leaders on the status of engineer forces, and all operations orders, warning orders, and fragmentary orders are posted in HTML format (see Figure 3).

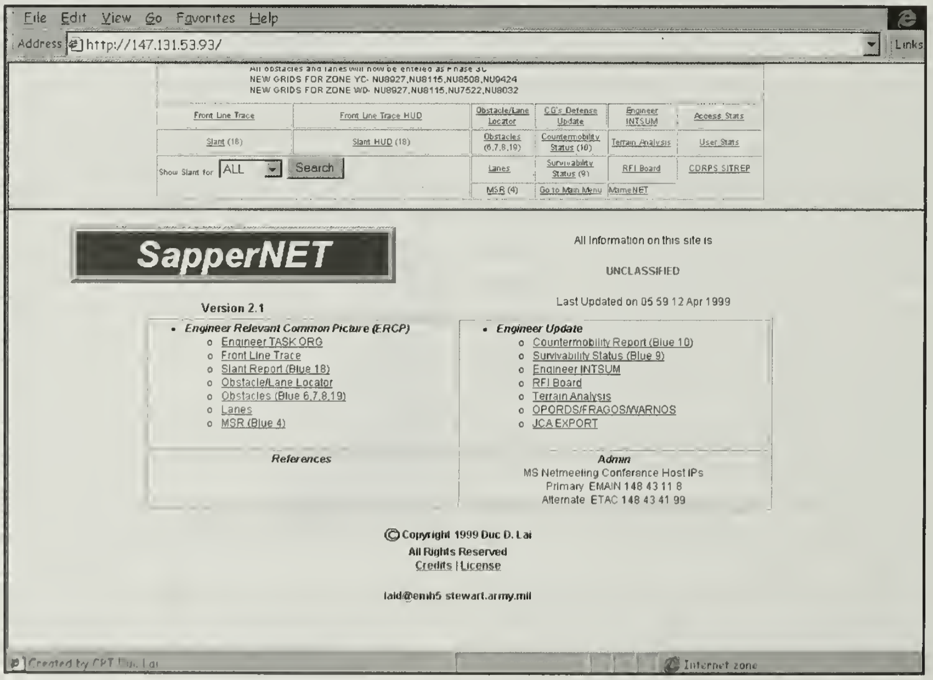
One of SapperNET's most often used features is the obstacle locator. Nonengineer units found this particularly useful in planning their movements in the battlespace. The locator allows users to define an area of the battlefield within which to search for obstacles and breach lanes. Entering coordinates for the northeast and southwest corners of a figurative box returns the desired results and provides a useful planning tool (see Figure 4, page 25). This process takes responsibility of data selection out of the hands of the data provider and into the hands of the data user.

Advantages

SapperNET's biggest advantage is near real-time information. During CPX 99-01, ETAC tracked the battle within two hours of "ground truth"; EMAIN was within four hours; and EREAR was about six hours behind. By CPX 99-03, SapperNET brought all command posts within one hour of ground truth. Used extensively by maneuver and combat service support units, SapperNET contributed immensely to situational awareness, resulting in almost no losses to known obstacles.

Another advantage of SapperNET is its ease of use. Anyone who has ever surfed the worldwide web can access and navigate SapperNET. Operator training for radio-telephone operators and battle captains took just 90 minutes.

SapperNET costs almost nothing and is extremely portable. It uses available hardware (some units access SapperNET using a 486 laptop with 8 megabytes of RAM) and maximizes the use of freeware/shareware so that the only expense is the license for ODBIC ($39 for a single license or $79 for unlimited licenses). A Dell Inspiron laptop with a Pentium II, 233 MHz processor, 64 megabytes of RAM, and a 3.5-gigabyte hard drive served as the web server. Finally, SapperNET is optimized for low bandwidth with no graphics; the entire application is less than 3 megabytes in size.



All obstacles and lanes will now be entered as Phase 3C
NEW GRIDS FOR ZONE YC- NU8927,NU8115,NU8508,NU9424
NEW GRIDS FOR ZONE WD- NU8927,NU8115,NU7522,NU8032

All Information on this site is

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Last Updated on 05 59 12 Apr 1999

Version 2.1

- *Engineer Relevant Common Picture (ERCP)*
  - Engineer TASK ORG
  - Front Line Trace
  - Slant Report (Blue 18)
  - Obstacle/Lane Locator
  - Obstacles (Blue 6,7,8,19)
  - Lanes
  - MSR (Blue 4)
- *Engineer Update*
  - Countermobility Report (Blue 10)
  - Survivability Status (Blue 9)
  - Engineer INTSUM
  - RFI Board
  - Terrain Analysis
  - OPORDS/FRAGOS/WARNOS
  - JCA EXPORT

References

Admin
MS Netmeeting Conferance Host IPs
Primary EMAIN 148 43 11 8
Alternate ETAC 148 43 41 99

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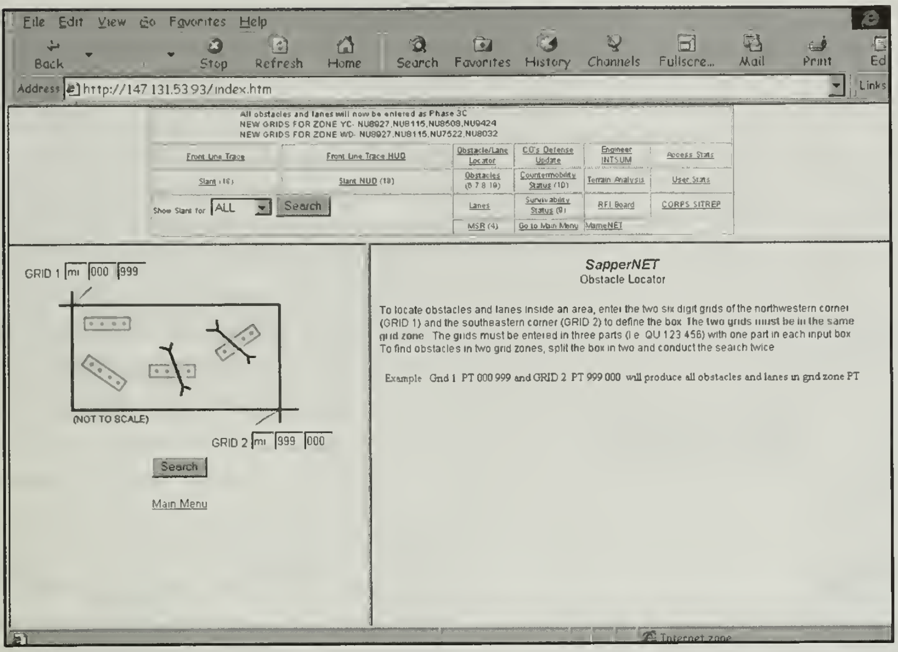
laid@emh5 stewart.army.mil

Figure 3. SapperNET Home Page



All obstacles and lanes will now be entered as Phase 3C
NEW GRIDS FOR ZONE YC- NU8927,NU8115,NU8608,NU9424
NEW GRIDS FOR ZONE WD- NU8927,NU8115,NU7522,NU8032

SapperNET
Obstacle Locator

To locate obstacles and lanes inside an area, enter the two six digit grids of the northwestern corner (GRID 1) and the southeastern corner (GRID 2) to define the box The two grids must be in the same grid zone The grids must be entered in three parts (i e QU 123 456) with one part in each input box To find obstacles in two grid zones, split the box in two and conduct the search twice

Example Grid 1 PT 000 999 and GRID 2 PT 999 000 will produce all obstacles and lanes in grid zone PT

Figure 4. Obstacle Locator Box

Still another advantage of SapperNET is its open architecture, which allows us to quickly develop and implement new capabilities after each after-action report. The obstacle search tool was just such a development. Changes like this and many others allow the information management system to adapt to the needs of the organization.

Finally, SapperNET exists on the TACLAN with the same classification as the MSE network—Secret High. Physically separated from the rest of the world, its security is as reliable as the MSE network.

Challenges

The main challenge of SapperNET is its dependence on MSE. The data channels are carried over the same airwaves as the voice channels for digital nonsecure voice terminals and MSRTs. Therefore, if the MSE network goes down so does TACLAN and SapperNET. One way we avoided prolonged downtime was by distributing the network. Duplicating the web server at both the EMAIN and ETAC allowed a redundant capability. These systematic backups of the database, transferred through the network to the alternate server, provided an alternative in the event of communication outages.

Another challenge of using MSE is low bandwidth. Using the Tactical Packet-Switching Network with a maximum throughput of 9.6 kilobytes per second results in slow-loading web pages. However, even with slow-loading web pages, sending a combat engineer slant report over SapperNET is faster than sending it over FM or digital nonsecure voice terminal. With the advent of the Signal Corps' high-speed multiplexing network at 256 kbps, SapperNET's performance improved tremendously.

SapperNET currently does not have the ability to provide graphical representations of the battlefield. For example, it cannot autoplot obstacles and breach lanes on a digitized map of the terrain. However, this capability is not far off. We are currently working a joint effort with the Engineer School to import SapperNET data into TerraBase II to autoplot the ERCP onto a digital map. Additionally, SapperNET will become the data source for XVIII Airborne Corps' Joint Countermine Application—a Global Command and Control System application being developed by the Corps engineer section to provide ERCP on a digital map.

A Viable Solution

SapperNET is a proven, cost-effective, and viable interim solution to manage and distribute the information necessary to provide the engineer-relevant common picture. Additionally, its low-cost, open-architecture design allows a high level of flexibility that can be adapted to almost any tactical unit. Recently, the XVIII Airborne Corps engineer section adopted SapperNET as the Corps engineer reporting and information distribution system. Once again, SapperNET was easily modified to accommodate Corps and light engineer-specific reports.

Captain Sellers is the Engineer Brigade Signal Officer at Fort Stewart, Georgia. Previous assignments include battalion adjutant, battalion assistant S3, MSE nodal platoon leader, and TACSAT platoon leader for 17th Signal Battalion, Kitzingen, Germany. A graduate of the Signal Officer Advanced Course, he holds a bachelor's degree in business administration from Appalachian State University.

Major Anninos is the S3 of the Engineer Brigade, 3d Infantry Division, Fort Stewart, Georgia. A graduate of the Command and General Staff Course, he holds master's degrees in systems engineering and transportation engineering from the University of Pennsylvania.

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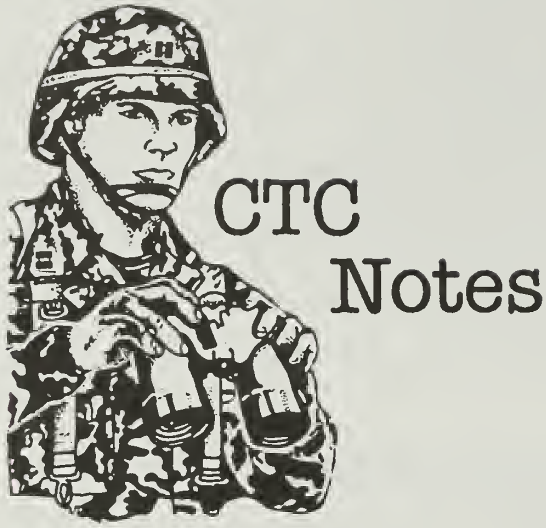

Battle Command Training Program (BCTP)

Integrating Smoke in the Mobility/Survivability BOS

By Lieutenant Colonel Ron Light and Major John Kulifay

If you are an "old soldier," you may recall a time when engineers were not fully integrated in the combined arms team. Engineers often had to "fight" to be heard, to secure a seat at the planning table, and so on. Due largely to the efforts of the combat training centers, I believe that this has changed. For example, during Warfighter exercises conducted by the Battle Command Training Program (BCTP), engineers are integrated in all stages of the military decision-making process and across the depth of the division zone. Brigade and division commanders seek the advice and counsel of their engineers. Thus, we are now a relevant, potent force on the battlefield.

However, engineers are only part of the mobility/survivability battlefield operating system (BOS). Division-level chemical staffs bring chemical detection, decontamination, smoke generation, and other capabilities to the fight. In particular, our experience during recent BCTP Warfighter exercises indicates that staffs must do more to integrate the use of smoke in plans and orders.

In light of the maneuver-support concept (which includes military police, who are not discussed here), and the fact that we are large consumers of smoke during river-crossing and breaching operations, engineers must take the lead in integrating our Chemical Corps brethren's smoke-employment expertise. If your first reaction is to dismiss this notion, perhaps you are not aware of the role that obscurants have played throughout the history of warfare and the great effects they can provide toward achieving success.

Pick a conflict, and you'll probably find that effective use of obscurants made a difference. As early as 2000 B.C., soldiers burned damp straw to smoke enemy positions. At Legnica, Poland, in 1241 A.D., the Mongols used smoke to separate foot soldiers and horsemen. Combatants in the 20th century have used smoke during every major conflict as well. The recently fielded M56 wheeled Smoke Generator System (SGS) and tracked M58 SGS have modernized our inventory of smoke-generating equipment.

Despite historic examples that showcase the effectiveness of smoke and recent improvements in equipment, our experience during BCTP Warfighter exercises shows that chemical staffs often are not integrated in the division fight. Where it was once engineers who fought for a seat at the table, now it's the chemical officers who fight for a seat. It is time that engineers facilitate the integration of chemical staffs, particularly for planning smoke operations on the battlefield. The importance of planning and executing smoke is clearly stated in FM 90-13, *River-Crossing Operations*, and FM 90-13-1, *Combined-Arms Breaching Operations*.

Chemical Corps doctrine (FM 3-50, *Smoke Operations*, and FM 3-101-1, *Smoke Squad/Platoon Operations*) provides the tactics, techniques and procedures units use to employ smoke at operational and tactical levels of war. Smoke has four battlefield applications:

- **Obscure.** Smoke is delivered directly on or immediately in front of enemy positions.
- **Screen.** Smoke is delivered on friendly forces or between friendly and enemy positions.
- **Protect.** Smoke is employed to defeat enemy guidance systems.
- **Mark.** Smoke is used to mark targets and identify friendly positions and prearranged communications.

Combat training centers provide the venue to plan and execute these smoke operations. Whether it is mechanically generated or emplaced by a soldier with a smoke pot, smoke is an effective combat multiplier. During BCTP Warfighter exercises, units that integrate chemical staffs and smoke operations on the battlefield generally are more successful than those that do not. Without early integration of the chemical staff's plans, smoke operations often are an afterthought, if they occur at all, and rarely are synchronized or effective. Planning for smoke should be accomplished at the division level. All too often, smoke assets are task organized to a brigade, where they are further task organized into smoke squads that are incapable of producing large areas of smoke. As one chemical officer noted, when that happens, smoke tends to be a beacon rather than an obscurant.

Figure 1 depicts a brigade-level river-crossing operation. While screening smoke was planned at brigade level, there was no division-wide smoke plan. The brigade generated smoke at a site along a major river, which the enemy observed and correctly surmised to be a river-crossing site. Note that little smoke was used elsewhere in the division zone; there was no plan to do so in support of the brigade river crossing.

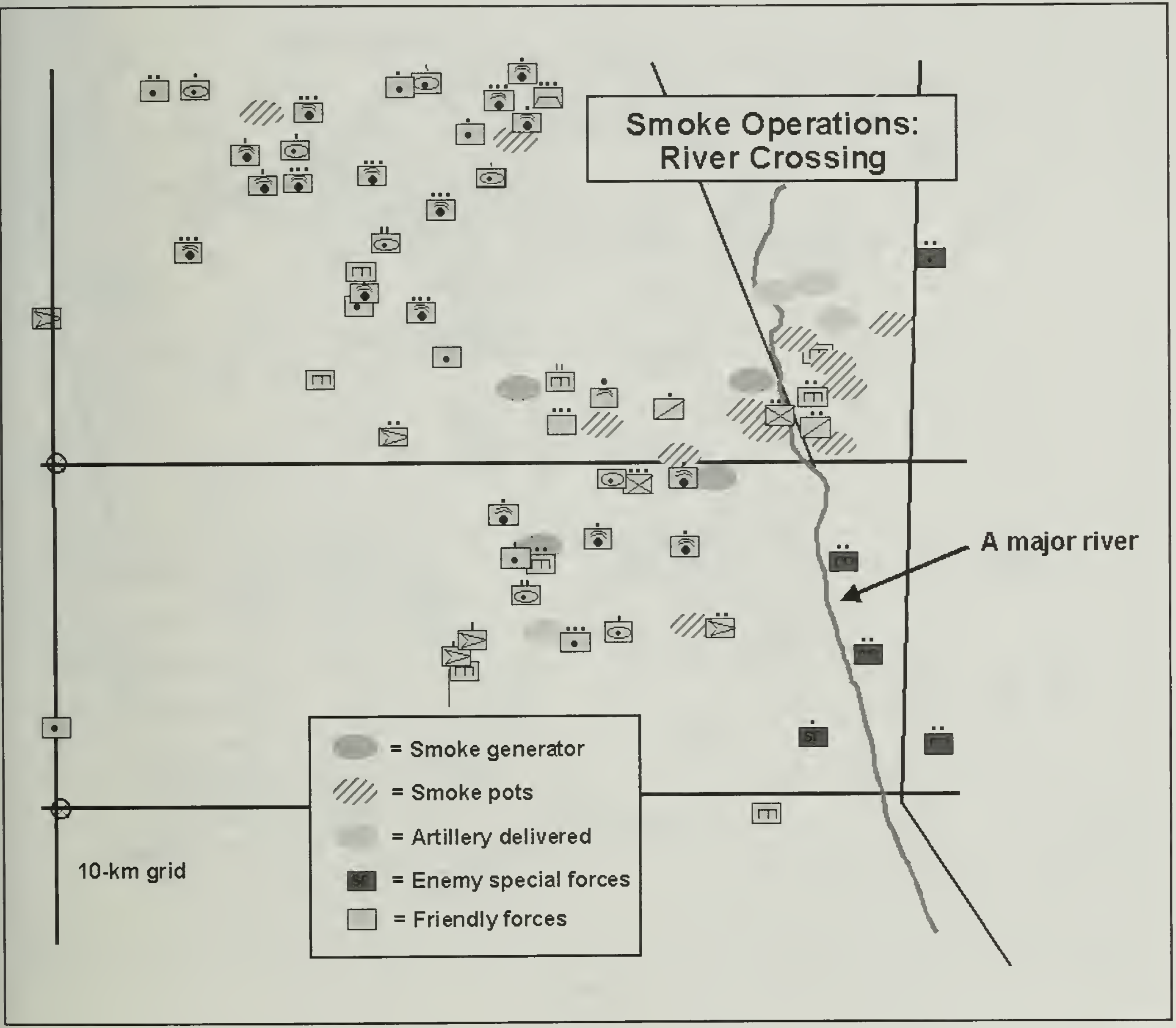

Figure 1

The use of smoke at only one place on the river made it easy for the enemy to detect and interdict the brigade's river-crossing operation.

Compare Figure 1 with Figure 2. In Figure 2, the chemical staff officer created an integrated, synchronized *division-wide* smoke plan that supported two brigade-level river crossings. Instead of using smoke at only a few places on the battlefield, the enemy was faced with many smoke events. The division executed screening and obscuring smoke across the depth of its zone. Accordingly, the enemy faced a dilemma with respect to potential river-crossing sites: *With limited assets, where should I send reconnaissance forces to look first? What do I target?* The enemy required additional time to identify the locations of river-crossing sites, and friendly forces conducted two successful crossings during that time. This is a classic example of "getting inside the enemy's decision cycle," and effective smoke integration made it happen.

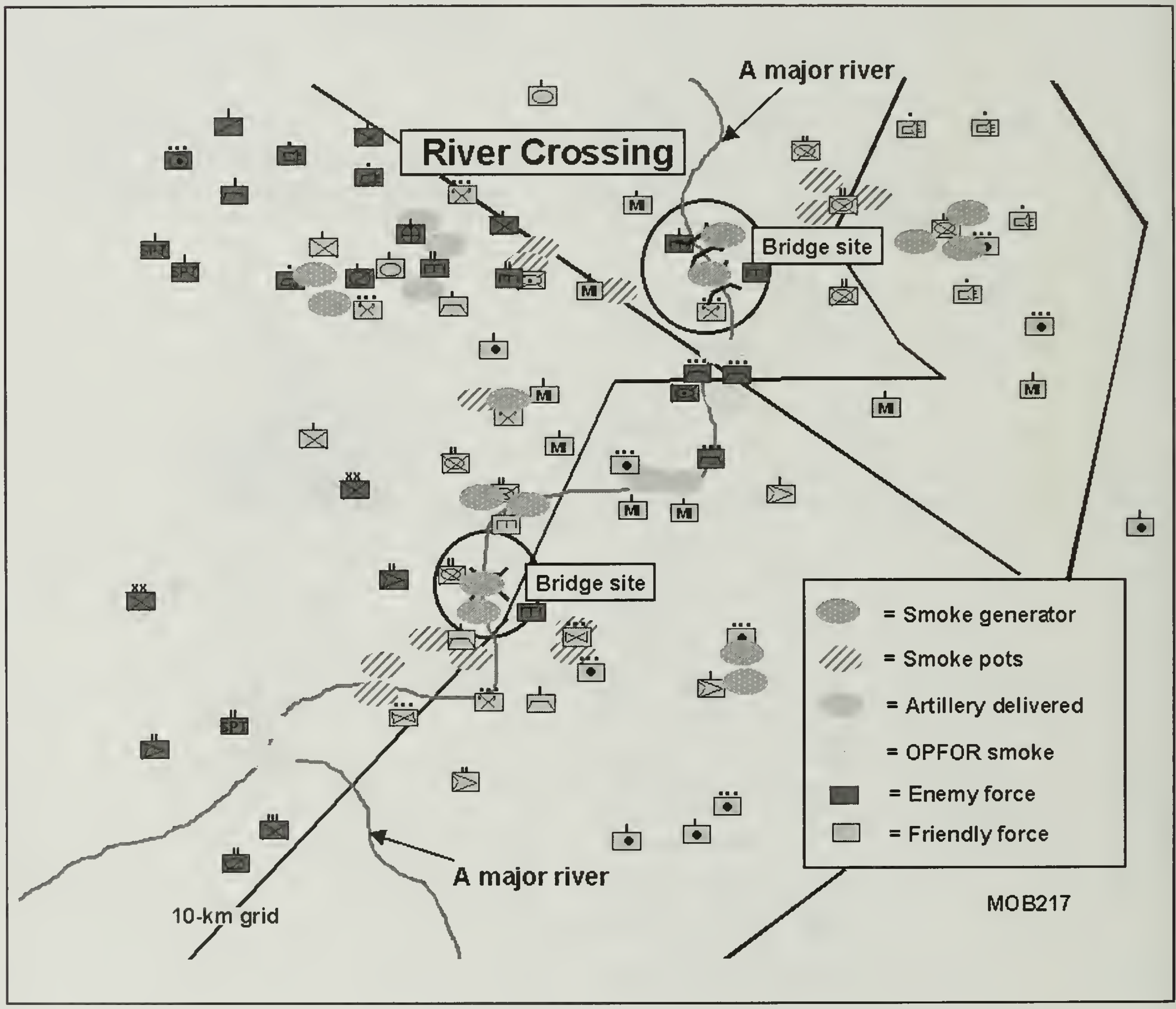

Figure 2

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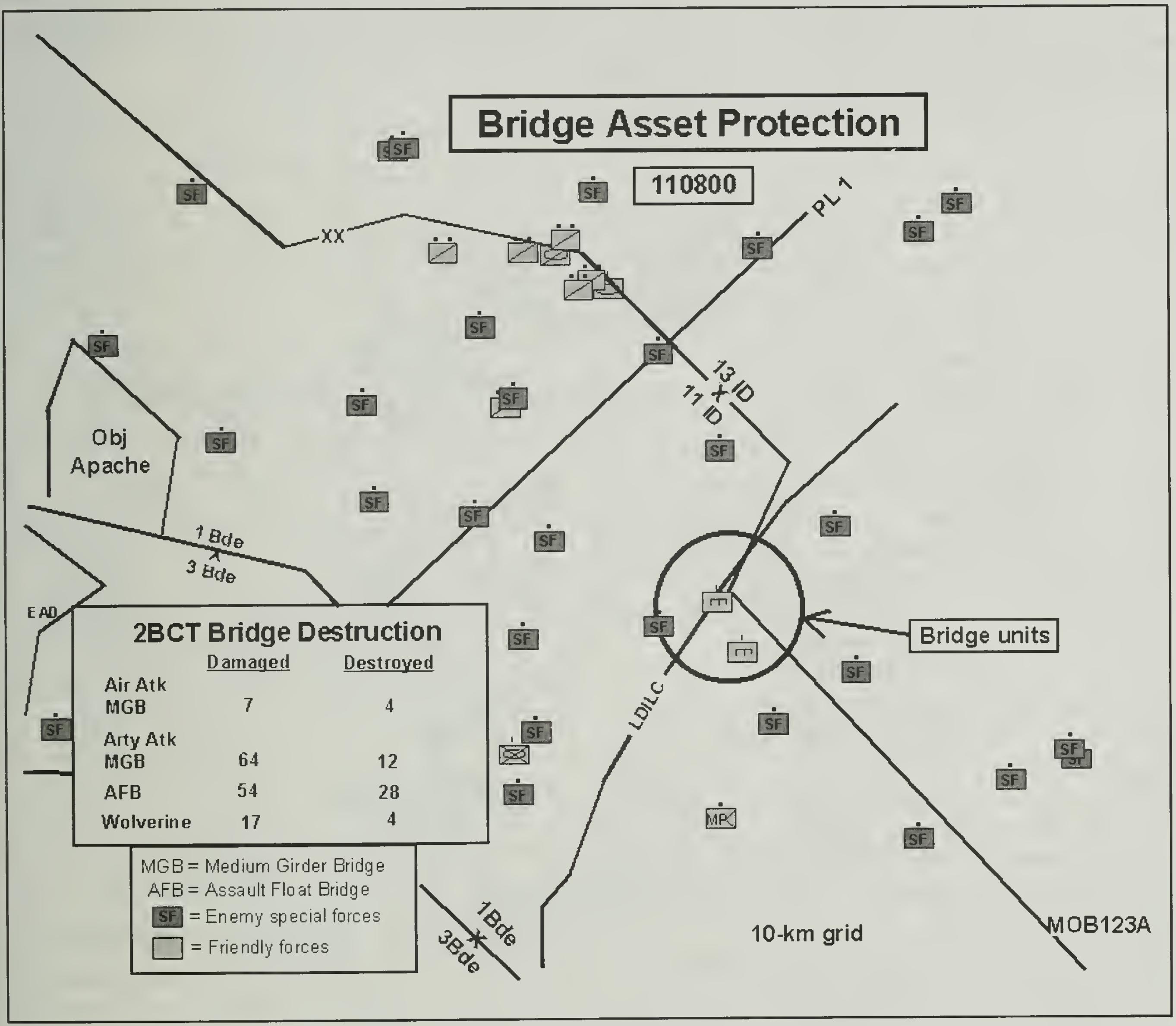
In most theaters of operation, we can expect large numbers of enemy reconnaissance forces. An effective smoke plan can help protect the force. Figure 3 shows a convoy of assault float bridge companies travelling to a river-crossing site. The enemy often includes engineers on his high-payoff target list, and in this case bridging assets were a priority target. Because these bridging units received no force protection from smoke operations, enemy forward observers (in this case special-purpose force [SPF] teams), brought effective fires on the convoy and partially destroyed it before the convoy could reach the river.

Figure 4, page 30, depicts effective smoke operations that enhanced force protection, again during multiple brigade-level river crossings. Note the location of enemy SPF teams, which are located along templated river-crossing sites. In this Warfighter exercise, friendly smoke was used effectively to blind the enemy's reconnaissance effort. Both river crossings were executed successfully.



2BCT Bridge Destruction

	Damaged	Destroyed
Air Atk MGB	7	4
Arty Atk MGB	64	12
AFB	54	28
Wolverine	17	4

MGB = Medium Girder Bridge
AFB = Assault Float Bridge
SF = Enemy special forces
▢ = Friendly forces

Figure 3

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River-crossing and force-protection operations are just two examples where effective smoke support can make a difference. Successful obstacle breaching also relies heavily on effective smoke support. A less used role for obscurants may occur when the defense is developed. There probably are other missions where smoke can be applied with positive effect. However, if the chemical staff is not integrated early in the planning process, this resource will be under- or unutilized.

The fire-support community often states, "No idle guns!" Similarly, engineers exclaim, "No idle blades!" As we transition to the maneuver support concept, let's not miss an opportunity to integrate the chemical staff's expertise in what we do to support the combined-arms team. Engineers are in the right place and this is the right time to secure a seat at the table for chemical staffs. Since smoke support makes us effective, we should lead the way in declaring, "No idle generators!"

Lieutenant Colonel Light is the senior engineer observer/controller for the Battle Command Training Program at Fort Leavenworth, Kansas. He previously served as the S3 and XO of the 168th Engineer Battalion, 3rd Brigade, 2nd Infantry Division, Fort Lewis, Washington.

Major Kulifay is the Battalion XO of the 23rd Chemical Battalion, Camp Carroll, Korea. Previous assignments include senior nuclear, biological, and chemical and smoke observer/controller for the Battle Command Training Program at Fort Leavenworth, Kansas, and chemical staff officer at corps, division, and brigade levels.

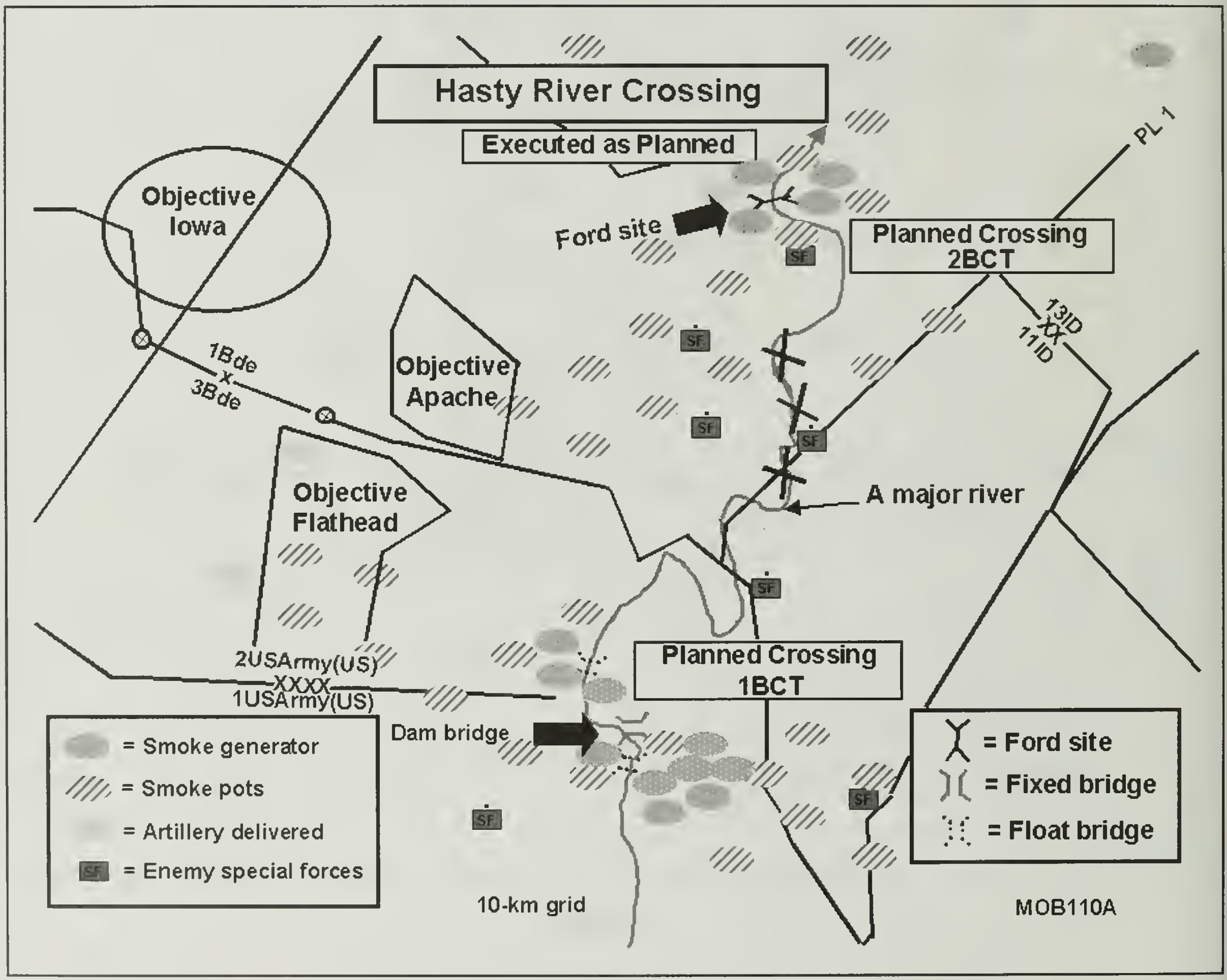

Figure 4

Joint Readiness Training Center (JRTC)

The Engineer Battlefield Assessment and Mission Analysis

By Major Jeff Baker

We are observing a trend at the Joint Readiness Training Center (JRTC) concerning the engineer battlefield assessment (EBA) and how it impacts engineers' ability to be viable members of the combined arms team. That trend is our observed inability to understand the purpose and end state of the EBA process. As a result, engineers rarely provide the maneuver commander with information during a mission analysis briefing (or targeting meeting) that is of any true value to his decision process. Engineer planners experience these difficulties because they do not understand the purpose of the EBA or tie it to the engineer estimate, which ultimately supports the military decision-making process (MDMP); nor do they understand the difference between "state" and "status." Many engineer planners believe the EBA is an engineer-specific document that is of little use for anyone other than engineers. Therefore, many units don't even produce a written EBA.

This article briefly describes the purpose and importance of conducting a thorough EBA as part of mission analysis. It is the first in a series of articles to be published in *Engineer* to discuss details of the EBA and mission analysis.

The "Substandard" Engineer Mission Analysis Worksheet

The following is an example of what we routinely observe as an EBA product.

Assets Available:

- Two light sapper platoons
- One mechanized engineer platoon
- Five dozers
- Eight small emplacement excavators (SEEs)

Specified Tasks:

1. Emplace obstacles in Obstacle Zone A.
2. Provide survivability support to the brigade task force.
3. Emplace a division-directed obstacle at WQ12345678.
4. Plan one scatterable minefield.
5. Submit obstacle plans to division NLT 231800Z FEB 99.

Implied Task: Be prepared to clear Route Falcon in support of the division counterattack.

Constraint: Division NLT defend time is 251800Z FEB 99.

Limitations:

- Authority to destroy bridges is reserved by the joint task force commander.
- No obstacles within 50 meters of Main Supply Route Raven.

If we ever see an EBA, this one is as good as it gets. What's wrong with this worksheet? All the planner did was pull elements from a higher order—no analysis was applied to the information. A properly prepared worksheet should give the supported commander details concerning the exact capabilities of engineer forces. It should list capabilities in terms such as number of breach lanes possible, number of protective positions engineers can construct in a given time period, linear meters of minefield engineers can emplace, minimum time required to clear/repair a flight landing strip given the type of soil and anticipated obstacles or damage, etc. Bottom line—we must *focus* our effort! Additionally, the above worksheet does not help the commander understand the mobility/survivability tasks required or the current state of the mobility/survivability operating system.

Purpose of the EBA

Simply put, the EBA is a mission-analysis tool that provides a structured way of conducting a detailed staff estimate. By following its format, the planner obtains a clear understanding of enemy engineer capabilities (which may produce additional implied tasks) and assists the task force S2 in preparing the intelligence preparation of the battlefield. The EBA also leads the planner to a detailed list of specified and implied tasks and a solid estimate of what the mobility/survivability operating system can provide to the task force. The planner should articulate this information in exact capabilities based on the task force's current state. The EBA must address engineer assets as well as the mobility/survivability operating system as a whole, although we rarely observe this critical aspect being conducted. The EBA must be conducted early in the MDMP, be updated continuously, and be in sufficient detail to provide the commander with a clear understanding of the *state* of mobility/survivability systems—not their *status*.

(Continued on page 60)

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MILITARY LOAD CLASSIFICATION TABLE

By Captain Patrick Rowe

The Engineer School web site contains a new feature for soldiers who are unsure of their vehicle's military load classification (MLC). The school has developed a table that pairs the most common vehicles in the Army's inventory with their MLC. Look up the table under *http://www.wood.army.mil/CELL/index.htm.* This web site belongs to the Doctrine Development Division's Center for Engineer Lessons Learned.

Earlier this year, *PS Magazine* informed the Engineer School that soldiers in the field may not have military load classifications readily available for their vehicles. This problem is the result of several factors. First, not all vehicle technical manuals contain the respective vehicle's MLC in the General Information section. Second, not all of the dash data plates attached to vehicles include that vehicle's MLC. Third, the new FM 5-170, *Engineer Reconnaissance,* lacks the MLC table included in the old FM 5-36, *Route Reconnaissance and Classification.* Fourth, Appendix F in FM 5-170 contains formulas for calculating field expedient classifications for vehicles. However, this requires soldiers to measure air pressure in tires and measure the total area of the vehicle's tires or tracks in contact with the ground.

Soldiers in the field must be able to quickly obtain vehicle MLCs without having to perform time-consuming measurements and calculations. With assistance from the Tank-Automotive and Armaments Command, the Engineer School developed the following table listing the MLCs of most vehicles in the Army's inventory. Line item numbers (LINs) and LIN index numbers have been provided to accurately identify the vehicles. The Engineer School will make this table available as a graphic training aid (GTA) and include it in the revised version of FM 5-103, *Survivability* (2nd quarter, FY00), and Change 2, FM 5-170 (4th quarter, FY99).

Table Header Definitions

Model: This field relates to the model description for a national stock number (NSN). Vehicles listed in the table are sorted alphabetically and numerically by their model number.

Item Description: This field relates to the generic nomenclature assigned to a LIN.

LIN: A six-character alphanumeric identification is assigned to generic nomenclature. It describes collectively all NSN items that possess the functional capability expressed by the LIN description. When multiple LINs are listed, the MLC of the heaviest vehicle is given in the MLC column.

LIN Index: This column provides the two-digit index number applied to each LIN data entry record to identify the NSN and shipping configuration. When multiple index numbers are listed, the MLC of the heaviest vehicle is given in the MLC column.

MLC E/L: This column provides the military load classification of the vehicle when empty/loaded. A dash (-) indicates that the MLC of the vehicle is less than three (3). A plus (+) indicates that the MLC of the loaded vehicle depends on the cargo.

Military Load Classification

Model	Item Description	LIN	LIN Index	MLC E/L
AVLB	Armored Vehicle-Launched Bridge, M48-based			46/66
AVLB	Armored Vehicle-Launched Bridge, M60-based			40/57
C7	Loader, Scoop 2.5 cubic yards (cy), w/o roll cage			20
D7	Dozer, w/ blade, w/o winch	W76816		23
D7	Dozer, w/ blade, w/winch			28
FLU-419	Small Emplacement Excavator (SEE) Tractor	T34437	03	9
JD-410	Tractor, Backhoe/Loader	W91074	01	9/10
M1000	Heavy Equipment Transport (HET) Trailer	S70859	01	21/-
M1037	Truck, Utility: S250 Shelter Carrier 4X4 w/equipment (HMMWV)	T07543	01	-/4
M1038	Truck, Utility: Cargo/Troop Carrier, 1.25 T 4X4 (HMMWV) w/equipment, w/winch	T61562	01	-/4
M1059	Carrier, Smoke Generator	C12815	01	10/12
M1068	Carrier, Armored, Command	C11158	01	13
M1070	HET	T59048	01	18/+
M1074	Palletized Load System (PLS) w/crane	T41067	01	24/45
M1075	PLS w/o crane	T40999	01	22/41
M1076	PLS-Trailer	T93761	01	7/26
M1078	Truck, Cargo: 4X4 light military tactical vehicle (LMTV) w/equipment, w/ or w/o winch	T60081	01	9/11
M1083	Truck, Cargo: MTV w/equipment, w/ or w/o winch	T61908	01	11/15
M1089	Truck, Wrecker: MTV w/equipment, w/winch	T94709	01	14/22
M109 A4/A5	Howitzer, 155 mm, self-propelled (SP)	K57667		28
M1090/ M1094	Truck, Dump, w/winch, MTV T65526 = w/o winch; T65594 = w/winch	T64911/ T65594/ T65526	01	12/17
M1097	Truck, Utility: Heavy Variant, HMMWV, 4X4, 1K gross vehicle weight (GVW), w/equipment	R93035/ T07679	36/10	-/4

Model	Item Description	LIN	LIN Index	MLC E/L
M110A2	Howitzer, Heavy, SP, 8-inch	K56981	07	26/29
M113A2/A3; M58	Carrier, Personnel; Wolf (M113-based)	D12087/ C18284/ G87229	17/01	13
M172, M172A1	Trailer, Low-Bed, 25-ton	S70517	01	7/29, 6/36
M198	Howitzer, Lightweight, Towed, 115 mm	K57821	01	9
M1A1	Tank, Combat, 120 mm, w/o Heavy Armor Kit	T13168	01	70
M1A2	Tank, Combat, 120 mm, w/o Heavy Armor Kit	T13305	01	70
M2A1	Infantry/Tube-Launched, Optically Tracked, Wire-Guided (TOW) Missile/ Cavalry Fighting Vehicle	F40307	01	22/28
M270/A1	Multiple-Launch Rocket System (MLRS)	Z57250	01	20/26
M270/A1	Trailer, Low-Bed , 12-ton	S70243	01/03	7/17
M2A2	Infantry/TOW/ Cavalry Fighting Vehicle	F40375	01	31
M2	Cavalry Fighting Vehicle	J81750	01	20/24
M3	Cavalry Fighting Vehicle	C76335	01	24
M35A2	Truck, Cargo: 2.5-ton, 6X6, w/equipment	X40009	01	6/11
M48A5	Tank, Combat, 105 mm	V13101	05	54
M520	Truck, Cargo, 8-ton			10/16
M54 series	Truck, Cargo: 5-ton, 6X6 long wheel base (LWB) w/equipment/ Truck, Cargo: 5-ton 6X6, w/winch, w/equipment	X40831/ X40968	07	9/17
M548	Carrier, Cargo, 6-ton	D11049	01	7/13
M54A1C/A2C	Truck, Cargo, D/S, 5-ton, 6X6	X40931	01/03	9/17
M551/M551A1	Armored Reconnaissance ABN Vehicle	A93125	01	14/16
M553	Truck, Wrecker, 10-ton, 4X4	X63436	01	15/20
M559	Truck, Fuel (2,500-gallon)			10/19
M56	Generator, Smoke, Mechanized (Coyote)	G58151	01	6
M577A1	Carrier, Command Post	D11538	01	10/12
M578	Vehicle, (Light) Recovery	R50544		27
M6	Carrier F/TRAC Bradley (Linebacker)	Z20340		33
M60A2	Tank, Combat, 152 mm	V13270	01	57

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Model	Item Description	LIN	LIN Index	MLC E/L
M60A1/A3	Tank, Combat, 105 mm	V13101	03/11	57
M728	Combat Engineer Vehicle	E56578	01	59
M747	C-HET Trailer (also M1000)	S70661	01	11/79
M813A1	Truck, Cargo: Dropside, 5-ton, 6X6, w/equipment	X40794	01	9/15
M814 series	Truck, Cargo: 5T, extra-long wheel base (XLWB)	A26874	11	10/21
M816	Truck, Wrecker, 5-ton, 6X6	X63299	07	18/32
M870	Trailer (pulled by M916)	S70594	01	6/74
M871	Trailer (pulled by M931)	S70027	01	7/52
M872	Trailer, Flatbed, 34-ton (M915 Tractor)	S70159	01,04,03	8/44
M88A1	Vehicle, (Medium) Recovery	ME1377	01	55/70
M997	Truck, Ambulance Litter, 4X4	T38844	01	-/4
M9 ACE	Armored Combat Earthmover	MB0589	01	17/30
M901	Combat Vehicle, Improved, TOW	E56896	01	12
M911	Truck, Tractor, 5-ton (C-HET)	T61035	01	16
M915A1/A2	Truck, Tractor, 6X4	T61103	03/14	8/-
M916	Truck, Tractor, 6X6	T91656	01	12
M920	Truck, Tractor, 8X6	T61171	01	14
M925A1/A2	Truck, Cargo, 5-ton	X40931	28	10/16
M929A2	Truck, Dump, 5-ton	X43708	42	10/17
M930A2	Truck, Dump, 5-ton, 6X6	X43845	35	11/17
M931	Truck, Tractor, 5-ton	X59326/ E01933	10	9/17
M93A1	Recon System NBC (FOX)	R41282	01	19
M966	Truck, Utility, 1.25-ton	T05096	01	3/4
M967, M970 (M900 series)	Trailer, Tank, Fuel, 5,000-gallon	S10059	01	6/21
M977	Truck, Cargo (HEMTT)	T39518	01	18/28
M978	Truck, Tanker (HEMTT)	T58161	01	17/25
M981	Fire Support Vehicle	C12155	01	14
M992	Carrier, Tracked , Field Artillery Ammunition Support Vehicle (FAASV)	C10908	01	22/29
M998 Series	Truck, Utility, Cargo, Transport Carrier, 1.25-ton, (HMMWV)	T61494	01	-/4

Model	Item Description	LIN	LIN Index	MLC E/L
MT-250	Crane, Truck Mounted, Hydraulic, 25-ton	F43429	01	31
RTCC	Crane, Wheel Mounted, (20-ton)	C39398	01	85/ +
(No Number)	Q37 Radar System	A41666	06	13
AN/TPQ-36V7	Q36 Radar System	R14216	05	-/4
M1083 w/winch	Truck, Cargo: MTV, w/equipment	T41135	01	11/16
M105A2	Trailer, Cargo: 1.5-ton 2-wheel, w/equipment	W95811	01	2/4
M35A2C	Truck, Cargo: Dropside, 2.5-ton 6X6 w/equipment	X40077	01	6/11
LMTV	Trailer, Cargo, 2.5-ton	Z36068	01	1/4
XM1113	Truck Utility: Expanded Capacity, 4X4 w/equipment, HMMWV XM1113	Z62562	01	-/6
(No Number)	Trailer, Cargo: MTV w/ dropsides	Z90712	01	3/9
Petroleum, Oil, and Lubricants (POL) MTV	Truck, Tank: POL MTV	Z94047	01	13
M1078 w/winch, w/o winch	Truck, Cargo: LMTV w/equipment (5K-pound Cargo)	T60149/ T60081	01	10/12
M1081	Truck, Cargo: LMTV w/equipment (5K pound Cargo)	T42063	01	10/13
M1093 w/winch, w/o winch	Truck, Cargo, MTV w/equipment (10K pound Cargo)	T41036/ T41104	01	12/16
Grizzly	Grizzly: Combat Engineer Vehicle, Full-Tracked (FTRAC)	Z23978/ Z23910	01	70
MLC 70	Launcher, M1 Tank Chassis (Wolverine)	Z37727	01	70

The Engineer School encourages feedback from users of these vehicles concerning information that is incorrect, omitted, or no longer necessary. Use the following e-mail or mailing address or telephone number to provide comments or suggestions to update and improve this table.

E-mail address: *Fmcommnt@wood.army.mil*

Mailing address: US ARMY ENGINEER SCHOOL, ATTN ATSE DOT DD WC, (MR WARRICK), DIRECTORATE OF TRAINING, 320 ENGINEER LOOP STE 336, FORT LEONARD WOOD MO 65473-8929

Telephone number: DSN: 676-4106; commercial (573) 563-4106; fax (573) 563-7740

Captain Rowe is attending the Engineer Officer Advanced Course. Previous assignments include Brigade Training Officer, 1st Armored Division Engineer Brigade in Germany; and platoon leader, 16th Engineer Battalion in Bosnia and Germany. CPT Rowe is a 1995 graduate of the United States Military Academy.

Book Review

Gulf War, The Complete History, by Thomas Houlahan, Schrenker Military Publishing, New London, New Hampshire, 1999, 471 pages, list $21.00 (paperback). The book is available online from Amazon.com.

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In this unusual book, the author has produced a comprehensive combined-arms account that includes the significant but largely unknown contributions of our British, French and Arab allies. The focus of the narrative is on the battalion and brigade levels, where real-time synchronization of combat power actually occurs. The book presents significantly more information than has been available on the Iraqis, including a good order of battle and their actions during the war. Many diagrams and maps help clarify the text. The thoroughness of the author's research has produced a balance that many military history accounts lack. In the process, the author has created a cogent analysis of why the coalition succeeded and the Iraqis did not.

The extent of the coalition's operational victory over the Iraqi Army in the Gulf War has created a myth that has obscured many of the tactical challenges that coalition soldiers had to overcome to achieve success. By interviewing many of the key participants in Operation Desert Storm (the list is more than eight pages long), the author was able to strip away much of the myth that has grown up around the Gulf War. For example, air power knocked out only about 600 Iraqi armored vehicles, not the 2,600 claimed by coalition air forces. Two of the three heavy divisions in the Republican Guard were destroyed (the other withdrew from the theatre of operations to avoid the ground war), and an additional three motorized divisions and one "commando" division were destroyed. Media hype aside, the Republican Guard still has not recovered from the severe mauling inflicted by American and British units during the ground war.

The contributions of combat engineers often are forgotten in military histories. Accounts by general officers paint with broad brushstrokes, while first-person accounts by individuals on the ground lack a tactical perspective and omit the less glamorous work of the sappers. Refreshingly, combat-engineer issues are well represented in this narrative, as shown by the following examples:

- Detailed accounts of major breaching operations conducted by the Marines, VII Corps, and the Arabs of the coalition, including many detailed sketches and photos.
- Information about the remarkable effectiveness of Iraqi field fortifications and decoys against the coalition air forces' sensors and munitions.
- Information on the first use of scatterable mines (primarily GATOR) by the United States since the Vietnam War.
- The casualties and delays caused by our (U.S.) unexploded submunitions that littered the battlefield. The Army has not yet adequately addressed this problem.
- A detailed analysis of all known fratricide incidents, including two that involved combat engineers.
- A description of what is probably the CEV's last close combat action at Al Bussayyah, where 20 rounds fired from its demo gun destroyed 19 heavily fortified buildings.

The author also provides a remarkably detailed accounting of casualties on both sides as well as their causes, allowing readers to assess the relative effectiveness of various weapons.

Combat engineers should find this book to be fascinating reading. It is recommended to all combat arms leaders.

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PRECOMBAT CHECKS AND INSPECTIONS

By Sergeant First Class Robert W. Casteel

The following checklists have been developed for general and Volcano-specific precombat checks (PCCs) and precombat inspections (PCIs). They are based on firsthand experience in units and from observing leaders at the company level and below who struggle to conduct effective PCCs/PCIs at the Joint Readiness Training Center (JRTC). This is by no means a 100 percent solution for correcting difficulties in conducting PCCs/PCIs or emplacing minefields with the Volcano system, but they may help your unit during the critical preparation phase. They have been forwarded to the Engineer School's Doctrine Development Division for inclusion in the next revision of FM 5-10, *Combat Engineer Platoon.*

Sergeant First Class Casteel is a writer/analyst in the Warfighter Engineer Division, Directorate of Training Development. Previous assignments include platoon and squad observer/controller at JRTC and platoon sergeant in A Company, 82nd Engineer Battalion, 1st Infantry Division, Bamberg, Germany.

PCCs/PCIs Checklist

This general checklist serves as a reminder of questions for leaders to ask:

Bolt cutters

- ☐ How many are on hand?
- ☐ How many are required?
- ☐ Do maneuver platoons have any?

Pioneer tools

- ☐ Are the kits complete?
- ☐ Are they serviceable?

Demolitions bags

- ☐ Have they been inventoried? Ensure they are complete, to include tape.
- ☐ Are they serviceable?
- ☐ How many are on hand per squad?
- ☐ Do maneuver platoons have demolitions bags?

Mine detectors

- ☐ How many are on hand per squad?
- ☐ How many are required per squad?
- ☐ How many D cell batteries are on hand?
- ☐ Where is a resupply of batteries available?
- ☐ How many probes are on hand?
- ☐ Do the maneuver companies have any?
- ☐ Have preventive maintenance checks and services (PMCS) been performed?

Load plan

- ☐ Are the vehicles loaded?
- ☐ Are the ruck sacks loaded?
- ☐ Are the soldiers' loads (load-bearing equipment, uniform, and A-bag) consistent with the SOP?
- ☐ Who is carrying the TOE equipment, and where is it located?

Obstacle lane-marking system

- ☐ Are enough marking materials on hand to mark eight lanes per squad?
- ☐ Who is carrying the immediate resupply?
- ☐ Are any other units carrying marking materials?
- ☐ Where can we get more materials (heavy/light)?
- ☐ How many picket pounders are on hand?
- ☐ What is the obstacle-marking SOP for the brigade/division?

Demolitions

- ☐ What is the demolitions count by type?
- ☐ Are the charges prepared according to the mission?
- ☐ Who is resupplying engineers with demolitions—the engineer company/battalion or the maneuver task force?
- ☐ Where is the supply point?
- ☐ What is the transportation plan? Are the modernized demolitions initiators (MDI) and demolitions being transported together or separately?

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☐ Do maneuver platoons have any demolitions available?

☐ What is the cross-load plan?

Volcano

☐ Have PMCS been performed according to TM 9-1095-208-23&P, *Unit and Direct Support Maintenance Manual for Dispenser, Mine, M139*?

☐ Have function checks been performed?

☐ Where are the mine canisters located?

☐ Where are the reload mine canisters located?

☐ What is the survivability plan?

☐ What is the control substitution plan if more than one Volcano is deadlined?

☐ How many operators are available?

☐ What is the protection plan for movement?

☐ Is a copy of the obstacle overlay available?

☐ What are the triggers for installation?

☐ What is the communications plan?

MICLIC

☐ Have PMCS been performed according to TM 9-1375-215-14&P, *Operator's, Unit, Direct Support and General Support Maintenance Manual for Demolition Kit, Mine-Clearing Line Charge (MICLIC)*?

☐ Have function checks been performed?

☐ Have circuit tests been performed?

☐ Where are the MICLIC tubs and rockets located?

☐ Where are the tie-down straps for the rocket located?

☐ Where are the reload tubs and rockets located?

☐ What is the survivability plan?

☐ Has a misfire kit been prepared?

☐ What is the control substitution plan if more than one MICLIC is deadlined?

☐ What is the communications plan?

Modular Pack Mine System (MOPMS) and Remote-Control Unit (RCU)

☐ Have PMCS been performed according to TM 9-1345-209-10, *Operator's Manual for Modular Pack Mine System (MOPMS)*?

☐ Have function checks been performed?

☐ Where are the MOPMS boxes located?

☐ How many BA 5598/Us are required?

☐ How many BA 5598/Us are on hand?

☐ Where can more BA 5598/Us be obtained?

☐ How many MOPMS boxes do the maneuver companies and the battalion have?

☐ How many RCUs do the maneuver companies and the battalion have?

☐ How many operators are in the infantry?

☐ Is a copy of the obstacle overlay on hand?

☐ What are the triggers for installation?

☐ What is the communications plan?

☐ Which is the overwatching unit?

Weapons zero

☐ Have individual weapons been zeroed?

☐ Have crew-served weapons been zeroed?

☐ Are tripods on hand?

☐ Are traverse and elevation (T & E) mechanisms on hand?

☐ Are spare barrels on hand?

☐ Are range cards on hand?

Rehearsals for offense/defense

☐ Are materials and personnel on hand to construct a rehearsal site?

☐ Have squad battle drills (engineer and infantry) been rehearsed?

☐ Have platoon battle drills (engineer and infantry) been rehearsed?

☐ Have maneuver battle drills been rehearsed?

☐ Have the actions on contact (seven forms) been rehearsed?

- Visual contact
- Physical contact (direct fire) with an enemy force
- Indirect fire
- Contact with enemy obstacles or those of unknown origin
- Contact with enemy or unknown aircraft
- Situations involving nuclear, biological, and chemical (NBC) conditions
- Situations involving electronic warfare tactics

☐ Have actions at halts been rehearsed?

☐ Have actions on the objective been rehearsed?

☐ Have actions in the assembly area been rehearsed?

☐ Have actions at base camps been rehearsed?

☐ Have reconsolidation and reorganization been rehearsed?

☐ Have actions on contact while deploying the Volcano been rehearsed?

☐ Have rollover drills with vehicles been rehearsed?

☐ Have fire drills with vehicles been rehearsed?

Vehicles

☐ Have PMCS been performed according to the appropriate TM?

☐ Are Class III basic loads on hand?

☐ What is the Class III resupply plan?

☐ Are spare parts on hand for vehicles and special equipment (if applicable)?

☐ Are unit identification markings on the vehicles?

☐ What is the casualty marking plan?

☐ Does each vehicle have a map and graphics?

☐ Have communications checks (short- and long-range) been performed?

Communications

☐ Are the AN/CYZ-10s loaded?

☐ Has communications security (COMSEC) been loaded?

☐ Are radio transmitters (RTs) loaded and the time set?

☐ Is there a 3-day supply of MANPACK batteries on hand?

☐ Are there spare HUB batteries on hand?

☐ Are there spare AN/CYZ-10 batteries on hand?

☐ Have communications checks (long- and short-range) been performed?

☐ Are the OE-254 antennas on hand and serviceable?

Night vision goggles

☐ Is there one pair on hand for each driver, track commander, and squad leader?

☐ Are AN/PVS-4s on hand for all M203 and M249 weapons?

☐ Are AN/TVS-5s on hand for all M2 machine guns and MK 19 weapons?

☐ Are there spare batteries on hand?

☐ Are there spare AA batteries on hand?

☐ Have PMCS been performed?

AN/PSN-11

☐ Has COMSEC been loaded?

☐ Is the AN/PSN-11 set up and initialized for the geographicial location?

☐ Are spare memory batteries on hand?

☐ Is there a 4-day supply of BA 5800s on hand?

☐ Are all authorized accessories on hand?

☐ Are the vehicle power and external antennas operational?

Class IV/V supplies

☐ What supplies are on hand?

☐ What supplies are on the battlefield?

☐ Are there enough in both places?

☐ Are more available?

☐ Who is in charge of them during offensive and defensive operations?

☐ What hauling assets are available?

☐ Where are Class IV/V supply points located?

☐ What is the unit SOP for setting up Class IV/V supply points?

☐ What equipment is on site?

☐ Are extra gloves on site for laborers?

☐ What is the accountability plan?

☐ Does the supply point have communications?

☐ Does the supply point have a copy of the obstacle plan or a breakdown of materials?

Traffic control point (TCP) materials

☐ Are wire and pickets on hand?

☐ Are mines on hand?

☐ Are sandbags on hand?

☐ Have guard shacks been constructed?

☐ What survivability materials are on hand?

☐ What is the United Nations TCP design?

☐ Where is the quick reaction force (QRF) located and what is its response time?

Mine-clearing blade (MCB)

☐ How many are serviceable and where are they located?

☐ Have PMCS been performed according to TM 9-2590-509-10, *Operator's Manual for Mine-Clearing Blade for M1, 1PM1, M1A1, or M1A2 Abrams Tank*?

☐ Are replacements and repair parts available?

Mine-clearing roller (MCR)

☐ How many are serviceable and where are they located?

☐ Have PMCS been performed according to TM 5-2590-214 *Operator's Manual for Roller Kit, Mine, and Mounting Kit, Mine-Clearing Roller?*

☐ Are replacements and repair parts available at the maintenance area?

M9 ACE

- ☐ Have PMCS been performed according to TM 5-2350-262-10?
- ☐ How many steel road wheels are on hand in the platoon?
- ☐ How many steel road wheels are in the battalion's prescribed load listing (PLL)?
- ☐ How many aluminum road wheels are on hand in the platoon?
- ☐ How many aluminum road wheels are on hand at the battalion PLL?
- ☐ What is the availability of petroleum, oil, and lubricants (POL) (15-40W, 10W, 90W)?
- ☐ Is the basic POL load located with the platoon sergeant or with the platoon leader?

Miscellaneous

- ☐ What support can we get from the maneuver company?
- ☐ What are the time lines of major meetings?
- ☐ What are the report times and formats?
- ☐ When are the critical face-to-face meetings with engineer command post (CP) personnel and the commander?
- ☐ When are the conference calls with the engineer commander via FM radio?
- ☐ When are the conference calls with the maneuver commander via FM radio?
- ☐ How often does the engineer CP want situation reports (SITREPs) from platoons?
- ☐ What is the time line for obstacle-marking-system upgrades?
- ☐ What is the maneuver time line for major events and meetings?
- ☐ What is the mission preparation time line?
- ☐ When is the intelligence update?
- ☐ Is a copy of the unit SOP available?
- ☐ Is a copy of the operations order (OPORD) and graphics available?

Volcano Checklist

PCCs/PCIs before deployment. Ensure that the following are on hand:

- ☐ All parts of the Volcano system
- ☐ Vehicle-mounted AN/PSN-11s (pluggers)
- ☐ A full load of M89 training canisters
- ☐ Electrical contact cleaner spray
- ☐ Canvas and bows
- ☐ TM 9-1095-208-10-1, *Operator's Manual for Dispenser, Mine, M139 w/Mounting Kits*
- ☐ TM 9-1095-208-23-2&P and parts manual
- ☐ FM 20-32, *Mine/Countermine Operations*
- ☐ FM 90-7, *Combined-Arms Obstacle Integration*

Planning considerations for deployment

- ☐ Ensure that for each 2-vehicle Volcano team, the following are on hand:
    - 2 Volcano system vehicles
    - 4 Volcano operators
    - 1 NCOIC
- ☐ Rehearse reload battle drill.
- ☐ Ensure that the following spare parts are on hand:
    - 1 Hand control unit (HCU) *
    - 1 Dispenser control unit (DCU) *
    - 2 Launcher rack cables
    - 1 Power cable
    - 2 Launcher racks *
    - 4 ID Connector shunt plugs (one for color/shape)

* *Indicates control substituted parts from another nonmission-capable system.*

Miscellaneous planning considerations

- ☐ Determine how many Volcano systems are on hand.
- ☐ Determine how many canisters are on hand.
- ☐ Determine if ground or air Volcanos are being used.
- ☐ Identify the effect of the Volcano minefield (disrupt, fix, turn, block).
- ☐ Use air Volcanos forward of the forward edge of the battle area (FEBA).

☐ Use Volcanos to develop the engagement area (EA).

☐ Determine the location of Volcanos on the ground.

☐ Identify the hide position locations.

☐ Identify the route to the minefield.

☐ Know when rehearsals are planned (day and night).

☐ Identify the decision points for situational and reserve obstacles.

☐ Identify the named areas of interest (NAIs).

☐ Identify the triggers and alternate triggers.

☐ Know the deception plan.

☐ Know which vehicle will be used for rehearsals.

☐ Plan for a backup vehicle, in case the primary vehicle breaks down.

☐ Prepare a reload plan, if needed (the suggested manpower is 12 personnel—eight on the ground and four on the truck).

☐ Know the survivability plan.

☐ Know the security along the route.

☐ Know the observer plan.

☐ Site the EA with the overwatching unit.

Survivability

☐ Dig survivability positions for each Volcano system.

☐ Park the air Volcanos with the attack helicopters.

☐ Move the Volcanos to new hide positions after each contact.

☐ Camouflage Volcanos in hide positions.

☐ Move the Volcanos at night (whenever possible).

☐ Have escort vehicles and dismounts in the front and rear.

☐ Clear, proof, and confirm route before moving the Volcanos.

PCCs/PCIs

☐ Establish communications with the platoon and company.

☐ Ensure that the AN/PSN-11s operate properly and have crypto.

☐ Run the built-in test before loading the canisters.

☐ Run the built-in test after loading the canisters.

☐ Ensure that operator vehicle maintenance (OVM) and basic issue items (BII) are on hand for the Volcano and carrier.

☐ Ensure that the obstacle plan is on hand.

☐ Ensure that the OPORD brief is on hand.

Rehearsals

☐ Perform day and night rehearsals.

☐ Use a HMMWV or a vehicle of equal size.

☐ Mark the centerline for day and night execution (at a minimum, the start and end points may need intermediate markers).

☐ Mark the evacuation routes for day and night.

☐ Perform rehearsals with the primary and backup operators.

☐ Rehearse a malfunction plan.

☐ Check the scatterable mine warning (SCATMINWARN) and report the communications net.

Maintenance

☐ Ensure that dirt and moisture are kept out of the racks.

☐ Check the operation of the Volcano system daily.

☐ Use TM 9-1095-208-10-1 for operator-level maintenance.

☐ Protect all cables from being stepped on.

☐ Keep a stock of cables in PLL.

☐ Perform a function test on the HCU and DCU.

☐ Check and clean the rack mounting ball detent pins daily. (Keep spares on the vehicle.)

Driver's Training: An In-House Solution

By First Lieutenant David P. Burris and Sergeant Lovetta M. Ritchie

When soldiers are injured or killed in an accident, it is sometimes because they lack the training to safely drive the vehicles they are required to operate and maintain. Well-trained drivers can handle emergency situations caused by track loss or a lack of steering response or braking power without panic, whereas untrained operators typically have accidents in these same situations. Drivers should not operate vehicles for even short distances without the correct training and licensing.

Personnel at the 5th Engineer Battalion at Fort Leonard Wood identified driver's training as a weakness across the battalion. To correct this deficiency, they developed a battalion-level program to train new drivers and re-educate current drivers. In addition to considering the requirements specific to Fort Leonard Wood, they evaluated the way driver's training had been conducted in other units to which they had been assigned. They also reviewed the following pertinent regulations:

- AR 600-55, *The Army Driver and Operator Standardization Program*
- AR 385-55, *Prevention of Motor Vehicle Accidents*
- FM 21-306, *Manual for the Track Combat Vehicle Driver*
- FM 21-17, *Driver Selection, Training, and Supervision: Track Combat Vehicles*

When developing the program, battalion personnel ensured that all facets of training were covered. They included driver maintenance responsibilities, driving in all types of weather and over all types of terrain, and emergency procedures peculiar to each type of vehicle. With the battalion's wide range of vehicle types (everything from M113A3s to HMMWVs to M916s to AVLBs), this was one of the most challenging blocks of instruction to develop.

Battalion personnel developed a 40-hour program that covered all aspects of vehicle operations, including mandatory accident avoidance training and a block of instruction covering night driving and the use of night vision devices. Instructors include the battalion's motor sergeant, maintenance technician, and Master Drivers. The schedule for the week-long class is shown in the figure. At the conclusion of the training, students are familiar with the HMMWV and are prepared to begin driver's training on larger and more complex pieces of equipment. Final licensing remains the responsibilty of Master Drivers within each company.

Many of the training aids used in the class were available through the installation's Training Support Center. These included videos on preventing driving while intoxicated; using seatbelts; and operating vehicles such as the HMMWV, 2.5-ton truck, and HEMMT. The lessons were compiled into a driver's training booklet that has space for students to take notes.

Since implementing the program in October 1998, the battalion has trained more than 50 new drivers. Feedback from the course has been very positive, and after each class an after-action review is performed to futher refine the training. The class is scheduled each quarter, and the schedule is published as part of the battalion's quarterly training guidance. This gives units time to plan and ensure that soldiers who need driver's training can attend the course.

Driver's Training Schedule

Day 1	
0800-0830	Course Introduction
0830-0930	TMs, LOs, Using DA Form 5988-E/2404, Equipment Inspection Maintenance Worksheet
0930-1030	Practical Exercise: Dispatch Procedures (DA Form 5988-E)
1030-1130	Safety Rules and Procedures
1130-1300	Lunch
1300-1400	Effects of Physical Laws/Loading Trucks
1400-1430	Accident Prevention
1430-1500	Accident Report Procedures (DD Form 518, SF 91)
1500-1600	Practical Exercise: Report an Accident
1600-1630	View Video TF (VT) 20-6374 "Consequences"
DAY 2	
0830-0930	Driving Under Adverse Road Conditions
0930-1030	View Video on Winter Driving Tactics
1030-1130	Practical Exercise
1130-1300	Lunch
1300-1400	Night Vision Goggle Introduction
1400-1500	Night Vision Driving
1500-1600	View Video "Night Vision Goggles"
1600-1630	Review
DAY 3	
0830-0930	View Video "Introduction to HMMWV Operations"
0930-1130	HMMWV Familiarization
1130-1300	Lunch
1300-1630	PMCS Instruction
DAY 4	
0830-0930	Review HMMWV Familiarization
0930-1130	Practical Exercise
1130-1300	Lunch
1300-1630	Review Practical Exercise
DAY 5	
0830-1130	Hands-On Test
1130-1300	Lunch
1300-1400	Comprehensive Test
1400-1430	Test Review and Course Critique
1430-1600	DA Form 348 Issues

For more information, call the battalion maintenance officer at (573) 596-0141 or DSN 581-0141.

First Lieutenant Burris is the 5th Engineer Battalion maintenance officer.

Sergeant Ritchie is the 5th Engineer Battalion NCOIC for PLL/TAMMS.

Sustaining Readiness—From the Bottom Up

By Colonel Joseph Schroedel

Company commanders often claim that they cannot manage their own training—that their schedules are driven from the top. Their chief concern is insufficient time to train individuals, squads, and platoons, which are the foundation of the combined-arms team.

More than ever, today's operational and training environment tests the time-management abilities of first-line commanders. Doing more with less is not feasible. Having more time is one solution, and an often-overlooked way to gain time is to make more effective use of our capabilities, especially our quality soldiers, leaders, and training doctrine. The key is to adopt training strategies that motivate individuals and small units to take responsibility for their own training, just as they would in combat.

Composition and Timing of Squad Stakes

Phase I: Leader Certification and Individual Task Evaluation. Begin this phase 90 days before Phase II.

- Leader Certification Exercise (before any evaluation).
- Common training tasks (CTTs).
- Army Physical Fitness Test (APFT) (conducted by the battalion within one week of beginning Phase II).
- Weapons qualification.

Phase II: Collective Task Evaluation. This four-day field training exercise (FTX) is conducted under battlefield conditions.

- *Prepare-for-combat lane:* Conduct precombat inspections (PCIs), rollover, and fire drills and acclimate to environment.
- *Attack lane:* Rehearse breaching, using the MICLIC, hand-emplaced mines, bangalores, and lane-marking equipment.
- *Defend lane:* Emplace row minefields, triple-standard concertina, Modular Pack Mine System (MOPMS), hasty road craters, and 11-row wire obstacles.
- *Maintain lane:* Conduct preventive maintenance checks and services (PMCS) and PCI verification.
- *Patrolling lane:* Navigate dismounted, react to direct and indirect fire, call for fire, and evacuate casualties.
- *Sustain lane:* Employ an M8 alarm; react to nuclear, biological, and chemical (NBC) attack; apply M9 paper; and execute mission-oriented protective posture (MOPP) exchange and personal decontamination.
- *Reconnaissance lane:* Conduct route and obstacle reconnaissance and sweep and clear the route.

Phase III: 12-Mile Ruck March. Perform immediately after Phase II.

- Maintain squad integrity through the entire march.
- This is a "test of will" – squads are exhausted after Phase II.

Figure 1

In combat, frontline soldiers own the motivation and responsibility to fight—and they will assume that responsibility. General Richard Cavazos captured it best when he said, "Show frontline troops an advantage, or there will be no battle." He was not only referring to soldiers' confidence in tactical plans but also to their confidence in themselves and their willingness to fight. Ultimately, our training programs must focus on this bottom-up motivation—to fight and to train to fight. It is the hallmark of the American way of war.

The decisive actions of individual American soldiers and small units are well known. General Wesley K. Clark, Supreme Allied Command, Europe, recently cited the motivation of nations that are seeking NATO membership: "It's not America's leading-edge technology that interests them. It's the discipline of our training; the commitment of our soldiers to each other; the cohesion, trust, and respect within our units; and the competence of our leaders and the trust exhibited by their subordinates."

That reputation was built on the quality of our soldiers, the competence of our leaders, and the effectiveness of our training doctrine. This article describes one method of stimulating bottom-up responsibility for training squads that are worthy of the American Army's reputation.

Squad Stakes

The 1st Infantry Division Engineer Brigade Squad Stakes is a three-phase training and evaluation program. It is a competition against tough standards, but unlike competition for Expert Infantryman Badges or Expert Field Medical Badges, squads are evaluated *as a squad* on both individual and collective tasks. Squad Stakes is also more than just an external evaluation. It is a comprehensive readiness program that integrates soldier, leader, and unit development; personnel, training, and resource management; and motivation. The bottom line is that Squad Stakes is designed to motivate training from the bottom to ensure that we are ready for any mission, anytime, anywhere.

Squad Stakes is a brigade-planned and battalion-executed program that integrates the engineer qualification tables (EQTs), mission-essential task list (METL)-related tasks, and individual combat skills into a single, comprehensive, scenario-based evaluation. EQT tables I through IV are included in Phase I, and tables V through VIII are included in Phase II. The METL crosswalk is used to ensure that all perishable individual skills and battle tasks are included. Figure 1 shows the composition and timing of each phase of Squad Stakes.

Semiannual Squad Stakes Scheduling

January	February	March	April	May	June
Leader Certification Phase I - - - - - - - - -	- - - - - - - - CTT Weapons	- - - - - - - - APFT	Phases II and III	Company STX (engineer platoon exercise evaluation)	CMTC

Figure 2

Squad Stakes reinforces the effectiveness of the Army's widely recognized training doctrine by focusing on the results of the training. The measure of effectiveness is not the outcome of the program; it is the performance of squads during combined arms training exercises such as those at the Combat Maneuver Training Center (CMTC). By scheduling the Stakes so they support sequential and progressive training plans of the supported maneuver brigades, engineer battalions make better use of available combined arms training opportunities. For example, if Squad Stakes is scheduled before company-level combined arms simulation training exercises (STX), quality engineer platoon exercise evaluations can be conducted during the company STX. A typical semiannual scheduling of Squad Stakes is shown in Figure 2.

Bragging Rights

Squad Stakes training is based on the fundamental assumption that soldiers will strive for excellence and maintain a high level of combat readiness if they—

- Can trust their leaders to be committed to maintaining squad integrity.
- Are held accountable to their squad for achieving and maintaining high performance standards.
- Can win recognition ("rights").

The objective of Squad Stakes is to stimulate bottom-up motivation to train by combining the effects of squad integrity, accountability, and recognition. These three principles work together to create a training environment that makes our training doctrine work as it was designed to work—from the bottom up.

Integrity

Squad integrity demands that leaders be committed to prudent personnel management practices. S.L.A. Marshall concluded in *Men Against Fire* that soldiers in combat fight for each other. The same must be true in peace. Our training programs, and not just those at our combat training centers, must place every soldier in the situation Marshall described. A squad's cohesion and confidence cannot be tested the first time against a live enemy. Soldiers must be able to work together, and Squad Stakes measures their commitment to each other.

Maintaining squad integrity is essential to building the cohesion and confidence necessary to succeed in combat. Our personnel management practices play a significant role in achieving commitment among soldiers. Whether assigning new personnel, task organizing for a mission, or managing personal development, our actions tell soldiers whether their team is as important to us as it is to them.

Some practices that contribute to squad integrity are—

- Manning squads at a level that permits some soldiers to be absent (for school, leave, etc) and still have adequate squad strength to conduct viable training.
- Minimizing personnel turbulence by reassigning soldiers for developmental reasons only, such as reassignment as a team or squad leader upon promotion.
- Attaching squads to platoons in another battalion when task organizing, which demonstrates the combat power effect of unit cohesion.

These and other practices establish the foundation for maintaining combat-ready squads. Once this basis for cohesion has been established, the squad can legitimately be held accountable for its training.

Accountability

Accountability of individuals to the team is vital to developing cohesion. Squad Stakes fosters individual accountability by integrating the evaluation of individual and collective tasks. The overall squad evaluation is a two-tiered process. First, all tasks are evaluated against Army standards. Then the results are combined to determine an overall squad evaluation. The important point is the integration of individual and collective evaluations.

The following example describes the effect of this integration: A squad failed to achieve Distinguished Squad status because one soldier failed the APFT by one sit-up. The individual wasn't blamed for the squad's failure. Instead, the squad realized that had they stayed together and pushed each other during the APFT, they all would have done better. They also discovered that Distinguished Squads had more vigorous physical training programs. They took these lessons to heart and achieved Distinguished Squad status on subsequent Stakes.

Squads are scored as a squad on every phase. While scoring is essential to setting high standards, Stakes is a training event. Failure to achieve minimum standards requires immediate retraining and re-evaluation. The scoring mirrors tank and infantry tables to reinforce a common combined arms language; a score of 900 is distinguished and 700 is qualified. Figure 3, page 46, shows the scoring for each phase.

The scoring system reinforces integration of individual and collective tasks by establishing high standards for each task as

Squad Stakes Scoring

Phase I: Individual Skills (300 Points)

- CTT: The squad is tested as a squad.

  100 points for all first-time GO.

- APFT: All members must pass the test.

If APFT score is:	Squad average score is:
290-300	100 points
270-289	90 points
250-269	80 points
240-249	70 points

- Weapons: Individuals are awarded points:

Expert: 100 points
Sharpshooter: 90 points
Marksman: 80 points
The squad score is the average of individual scores.

Phase II: Squad Drills (600 Points)

- Consists of six lanes of 100 points each, with four to six drills per lane.

Score on each lane: Percent of subtasks correctly accomplished x 100.

Failure of one critical subtask = failure of task.

Phase III: 12-Mile Ruck March (100 Points)

- Start, execute, and finish as a squad.

Score: 3 hours or less = 100 points
3-4 hours = 90 points
4-5 hours = 80 points

Figure 3

well as for the overall event. The ultimate objective of every squad is to achieve recognition for its continuous training efforts. It is impossible to achieve distinguished status without continuous training.

Outstanding performance is recognized by a Distinguished Squad Badge—a distinctive bronze badge attached to a leather tab and worn suspended from the inner button of the right upper BDU pocket. To earn this badge, a squad must achieve a first time GO on every task and achieve an average score of 90 percent or more for all phases combined. To date, the success rate is 20 percent.

Visible recognition is important to soldiers. In addition to the badge, the distinguished squad symbol is stenciled on squad vehicles.

Recognition

Recognition is fundamental to motivation. Soldiers and leaders must want to train every day. Given the proper motivation, they will find ways to control the impact of limited resources, "hey you" missions, and other distractions that are often cited as reasons why training cannot be conducted. Clearly, it takes more than just a badge to stimulate motivation. Squad Stakes stimulates motivation for rigorous and continuous training by making recognition meaningful through the following:

- High but achievable standards.
- Squad leader responsibility for achieving results.
- Integration of the full range of individual and collective tasks.
- Competition against standards rather than the performance of other units. The best unqualified unit is still unqualified.
- Visible recognition of performance (bragging rights).
- Reinforcement of the chain of command.

We have all known or been members of teams that exceeded the wildest expectations of the collection of average individuals brought together by fate. We have experienced the power of teamwork when it raises the level of every individual beyond their best performances. We have experienced the bonds of shared hardships and the resulting commitment to the team over any individual. Squad Stakes capitalizes on the power of those human experiences.

We have also experienced the human desire to advertise our association with a winning team. Pride is born of success against tough odds. Bragging rights belong to the team whose long-term commitment to hard work lifts them to the highest standards of team and individual performance.

Squad Stakes bragging rights include:

- Award of the Distinguished Squad Badge by the division commander. (The CG pins a badge on each recipient.)
- Award of a division commander coin.
- Award of an Army Achievement Medal to each squad member.
- Award of a serial-numbered engineer brigade coin and a coin certificate.
- Squad entry into the Engineer Brigade Hall of Honor.
- Selection for special training missions.

Special Missions

Squad Stakes does not end at the finish line of the ruck march. Distinguished squads are immediately given priority for special training missions, such as—

- Bern, Switzerland, 50-kilometer ruck march (squad members earn Swiss commendation medals).
- Nijmegen 100-mile ruck march (squad members earn medals).
- Elbe Stoehr best-ranger competition, an international infantry competition (teams may win trophies).

Special missions help sustain the motivation to maintain a high level of readiness. They give squads tougher challenges to prove their true worth and afford further opportunities for recognition. Special missions also demonstrate the commitment of the chain of command to achieving and maintaining high standards. Squad Stakes reinforce the chain of command in other ways too.

Reinforcing the Chain of Command

Leaders are responsible for setting and enforcing standards. One critical element of the Squad Stakes is the role of leaders. All leaders are employed in a manner that reinforces the chain of command, takes greater advantage of the experience and responsibilities of senior noncommissioned officers, and provides opportunities for leader development. Some leaders' roles are listed below:

- Brigade commander: Establish and enforce standards.
- Brigade command sergeant major: Conduct Brigade Leader Certification Exercise.
- Battalion commander: Plan and execute Squad Stakes.
- Battalion command sergeant major: Train and evaluate platoon sergeants.
- Company commander: Train platoon leaders and operate company command post.
- Company first sergeant: Train platoon sergeants and monitor lane standards.
- Platoon leaders: Serve as lane officer in charge and evaluate troop-leading procedures (follow the squad in its own track while negotiating each lane).
- Platoon sergeant: Serve as lane NCO in charge and evaluate all tasks (ride with the squad).
- Squad leader: Lead the squad to achieve standards.

Leader Certification Exercise

Before every Squad Stakes, a Brigade Leader Certification Exercise is conducted to ensure that all leaders understand the standards and how to evaluate individuals and units against the standards. Using Army standards for all tasks, the brigade command sergeant major organizes and runs the exercise with the assistance of the battalion command sergeants major. Company first sergeants serve as trainers for the exercise. The primary training audience is platoon sergeants since they are the chief evaluators during the Squad Stakes. The exercise consists of the following steps:

- Each platoon sergeant is issued a copy of the evaluation standards.
- All platoon sergeants simultaneously observe the execution of each task by an individual or squad (videotape is an option).
- All platoon sergeants independently grade the task.

After each task is evaluated, the command sergeants major discuss whether each subtask should have been evaluated as GO or NO GO. Discussion continues until all platoon sergeants clearly understand how the task should be performed.

Squad Stakes places senior NCOs in teaching and mentoring roles. Too often first sergeants and platoon sergeants become focused on administrative and logistic functions at the expense of their tactical expertise. Not only is their experience irreplaceable, their example is critical to the development of junior NCOs and officers.

Leader Development

Squad Stakes offers several opportunities for developing leaders. For platoon leaders, participation in the Leader Certification Exercise and the Stakes is one of their most significant developmental experiences. During the certification, they gain an appreciation for the professionalism, knowledge, and experience of their platoon sergeants by observing the execution of each task and the subsequent discussions among senior noncommissioned officers.

During the Stakes, platoon leaders serve as platoon leaders on a lane. They are responsible for issuing the order to squad leaders, accepting reports (according to the tactical SOP) during the conduct of the lane, and evaluating troop-leading procedures at the conclusion of the lane (by conducting an after-action review with squad and team leaders). Since troop-leading procedures are not scored as part of the evaluation, new platoon leaders are routinely tasked to head lanes (with their own platoon sergeant) to give them the experience of leading squads. This provides platoon sergeants with an ideal opportunity to establish a closer relationship with their platoon leaders and begin the training process of our Army's newest leaders.

The brigade derives much from this exercise: increased cooperation between battalions, greater standardization of unit performance, increased professional development of leaders, and more. The ultimate benefit is the ease with which task organizations are built because of the clear understanding of standards between units. Maneuver units confidently expect, and receive, the same standards of performance from any unit in the brigade.

Summary

Squad Stakes is a comprehensive readiness program that combines the effects of commitment to squad integrity, the dynamics of squad members holding each other accountable for maintaining high levels of readiness, and worthwhile recognition for outstanding performance. Whether squads achieve distinguished squad status or not, they are motivated from within to take responsibility for their training. They strive to achieve and maintain a level of combat readiness that instills a strong sense of confidence in their ability to fight any enemy, win, and survive to fight again.

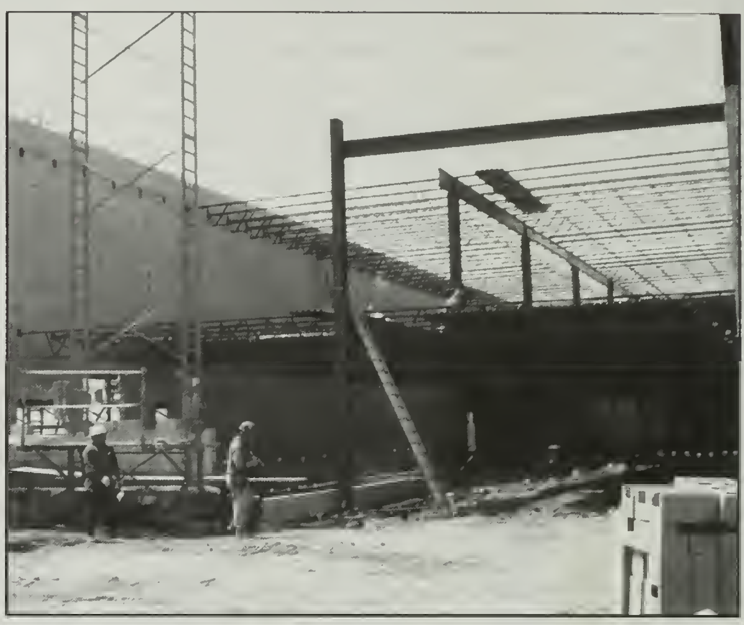
Colonel Schroedel is executive officer for the Secretary of the Army. He previously commanded the 1st Infantry Division Engineer Briagde and the 1st Engineer Battalion. COL Schrodel has served in tactical units throughout most of his Army service.

Delivering High-Quality Products With the CPM

By Captain Ivan P. Beckman

The goal of the U.S. Army Corps of Engineers is to deliver high-quality projects to its customers—on time and at cost. The Critical Path Method (CPM) of construction management is one technique used to achieve this goal. The CPM is a graphic tool for coordinating five aspects of construction—time, people, materials, equipment, and money.

While every construction contract would benefit from using the CPM, it is often neglected by both the government and the contractor and used only to process pay applications. However, the CPM is essential to fighting unnecessary time delays and cost overruns. As effort is put toward the critical path, certain elements may no longer remain critical and other key tasks may become critical. The CPM is essential in identifying the migration of critical elements. This article describes how everyone involved in a construction project benefits from using the CPM and gives examples of how it can be applied in the field.



Using the CPM helps keep construction projects, such as this maintenance facility at Tinker Air Force Base, Oklahoma, on schedule.

Valuable Tool

The Critical Path Method is a valuable tool for the government, the customer, and the contractor. By using this graphic management tool, it becomes obvious when unexpected events affect a project and require coordination.

Government

The government's representative must challenge every proposed change against the CPM and force the contractor to use his schedule. The CPM is a tool to supervise and manage construction and to prevent unnecessary delays in critical path activities. For example, the customer may request a minor change in an activity that will impact a critical activity. The government should use the CPM to show the customer how the change will delay the contract completion date and increase overhead costs. This information, which the customer may have overlooked, will help with decision making at all levels. The government should use the CPM as a negotiating tool by challenging time extensions for modifications and allowing them only if the contractor proves an impact on the critical path.

Customers

Customers should use the CPM as a requirements and date planning tool. By following the CPM, they will gain a greater understanding of a project's completion, which may be before or after the original estimate, and they will know when to move tenant units into and out of facilities. Customers can use the CPM to develop their own movement time line. They will also know when to provide equipment to the contractor that is government-provided/contractor-installed, based on the contractor's schedule.

Contractor

By correctly applying the CPM technique, contractors can greatly improve their job performance through resource leveling. Prime contractors can cross-level and focus their labor force and equipment on activities that have critical path importance. Subcontractors can see how their work fits into the project and can improve scheduling, planning, and ordering. Construction superintendents and project managers must be the primary keepers of the CPM.

Applying the CPM

Use of the CPM in field units saves time and money. It allows contractors as well as the government and customers to realize the relative importance of every construction activity based on the float time available and network logic. An activity that is delayed more than the allowable float time delays the entire construction project by the same amount of time. Delays that affect the critical path of a project are costly to contractors and the government. If a project is delayed, the contractor pays his extended overhead

How the Critical Path Method Works

The following examples show how the CPM can be used:

Project One

A contract modification was required to change the size of a chiller and provide additional cooling capacity in a new facility. The chiller had not yet been ordered. The contractor claimed an additional 28 days of delay for which he was due a time extension and extended overhead in the amount of $56,000. The potential time extension would cause the user-need-by date to be missed by a month. The new facility's user had invested considerable time and planning in an anticipated turnover date and would experience planning difficulties and added cost to extend a lease and delay the movement. During negotiations, the government required the contractor to use the CPM to explain his time extension request. The contractor identified one key activity in the CPM—"Install Chiller"—that the change affected and which caused all other delays. A study of the CPM showed that "Install Chiller" had 43 days of float time. The activity's early-start date was more than 12 weeks away, while the contractor's proposal cited a 12-week period to order and receive the chiller. The government representative suggested that through the logic of the contractor's CPM, he was not due additional time for the modification. The contractor, not able to argue against his own logic, conceded that the additional time extension was not required and dropped the requested time delay from the proposal. This saved the government considerable money and time.

Project Two

The project superintendent and quality control manager conducted construction planning on the project CPM, which was posted in the office trailer. The contractor updated activities with actual start and finish dates and color-coded activities to indicate completion status. The superintendent used the CPM to notify subcontractors of upcoming work requirements. Subcontractors used the CPM to schedule their work based on the completion of the preceding construction activities. The contractor used the CPM to closely watch critical path activities, which received priority effort. The contractor effectively cross-leveled resources (workers and equipment) for the benefit of the project. On this project, the contractor could boast that he was still on the original schedule despite 27 days of weather delay. This was mainly due to the contractor's understanding and application of the CPM technique on the job. It is important that project superintendents master their project schedules and the CPM technique early in the life of their projects.

along with liquidated damages. However, if a contractor is granted additional time as part of a modification, the government pays the price with money and time. The government must challenge each time extension against the CPM to determine if it is legitimate and then appropriately compensate the contractor.

Using the CPM also improves construction quality. Contractors can schedule construction activities during the best conditions within float-time windows. For example, it is not necessary to rush a concrete project during the winter if there is adequate float time for the activity to be done in the spring. Depending on preceding and subsequent activities, it may be possible to pour floor slabs after a weather-tight facility is built to control concrete curing conditions. Float time and network logic can and should be used to schedule activities under the best possible conditions.

The following suggestions may help project engineers apply the CPM in the field:

- **Scrutinize the preliminary CPM**. Contractors are required to provide the government with a preliminary CPM within 30 days after a notice to proceed, which covers the first 60 days of work. During that 60 days, contractors must produce a detailed initial CPM that covers the entire contract.
- **Scrutinize the initial CPM.** Ensure that construction superintendents and project managers explain their initial CPM in detail. Some contractors hire a subcontractor to write the CPM, and the subcontractor may turn it in for approval without the construction superintendent seeing it. Carefully review a contractor's submittal, and if the schedule doesn't seem logical, require a resubmission.
- **Emphasize construction superintendents' ownership of CPMs.** Superintendents must understand the logic of their CPMs and the importance of critical path activities. They must know which activities have float time and how much time is available per activity. Ensure that superintendents post their CPM in their construction trailer and keep it updated. Using the superintendents' CPM as a guide, frequently discuss the construction status with superintendents and project managers.
- **Scrutinize contractors' CPM updates.** Contractors are required to submit an updated CPM with every pay application along with a short narrative describing changes in the network since the last pay application. Reject the pay application if an update is not included. Ensure that contractors follow their own schedules.
- **Use the CPM in negotiations.** Contractors must use the CPM to justify all requests for time extensions due to weather delays and construction modifications. Contract time extensions should be granted only if critical path activities are delayed.

Key to Success

The Critical Path Method is the construction management tool of choice for project engineers in the field. When it is applied correctly, the government protects itself from excessive time delays and cost increases; contractors provide higher-quality projects on time and at cost; and customers gain a greater understanding of projects and increase their ability to plan. A mutual understanding of projects through the CPM provides the government, contractors, and customers the key to construction success.

Captain Beckman is a project engineer in the Tulsa District, U.S. Army Corps of Engineers, Southwest Division.

PALLETIZED LOAD SYSTEM:

STREAMLINED ACQUISITION SUPPORTS ENGINEERS

By Peter Motzenbecker and Gregory C. Edgin

An article in the April 1995 issue of *Engineer*, "Applying PLS Technology to the Engineer Fleet," detailed the benefits of load-handling system technology to engineers. The article illustrated some proposed equipment changes that resulted from inserting the Palletized Load System (PLS) as a prime mover in engineer combat heavy battalions. Since then the PLS project manager has worked with personnel from the U.S. Army Engineer School to refine engineer user concepts and economically produce PLS-compatible hardware for soldiers in record time. By employing streamlined acquisition initiatives and the integrated team approach, they have made it possible to field the first engineer-specific mission modules 31 months after initiating the acquisition process (see figure). This represents a significant decrease in the normal product acquisition time of 48-60 months and allows the integrated process team (IPT) to get badly needed, modernized equipment into the hands of soldiers.

PLS Engineer Mission Module Time Line	
Start acquisition process	February 1997
Award contract	September 1997
Deliver hardware	March 1998
Complete OT/DT	December 1998
Begin fielding	September 1999

Analyzing the Need

Engineer School personnel and the PLS project manager commissioned a detailed analysis of engineer units and missions to determine the best way to exploit the mobility and interchangeable payload/module capability of the PLS truck. Analysis showed that significant savings could be achieved using the PLS rather than currently fielded equipment, particularly for horizontal construction tasks. For example, in the 40-mile "Road Damage Repair" task, PLS trucks and trailers outfitted with a PLS dump module reduced project completion time by 68 percent. Using the PLS truck and trailer to complete the "Ammunition Storage Construction" task resulted in a 53 percent reduction in project completion time.

The PLS and engineer communities decided to pursue procurement of the PLS flatrack-based engineer mission modules (EMMs) to replace the individual, single-purpose systems acquired in the past. For example, the M918 bituminous distributor and the M919 concrete mobile mixer were fielded in the 1970s and had less-than-favorable operational readiness histories. Both systems were mounted on dedicated chassis and, by the nature of their missions, were used infrequently. To complete the modular concept, another system—a dump truck—was needed to supplement the bituminous distributor and concrete mobile mixer.

An EMM integrated process team was formed in February 1997 to review the available information. The team visited a field unit that had M917, M918, and M919 trucks; viewed the equipment in its operational environment; and interviewed soldiers. The team evaluated individual features of the equipment for incorporation of commercially available improvements. The goal was to reduce acquisition and support costs while increasing performance.

An example of needed improvements was the concrete mobile mixer's auger bearings. They had to be greased before every use but still some failed when the mixer operated in a harsh alkaline environment. The IPT identified a need for sealed, lube-for-life bearings.

As with other types of sustainment engineering equipment, the EMMs would be nondevelopmental items. Therefore, emphasis was placed on standard commercial equipment and features. The intent was to mount the standard commercial body on a standard PLS-compatible M1077 flatrack. The only nonstandard features would be those needed to integrate the body onto the flatrack.

Engineer Mission Modules

The evaluation process resulted in a low-rate-initial-production contract for the following EMMs:

Bituminous Distributor

This 2,800-gallon unit has computer-controlled spray rates that adjust to changes in vehicle speed, which is sensed by a radar unit that does not require ground contact. Two diesel-fired burners heat the bitumen. A folding spray bar is a unique feature required to integrate the unit on the PLS flatrack. A universal power interface kit (UPIK) mounted on the PLS truck provides hydraulic, electric, and pneumatic power connections through the use of quick-disconnect fittings.

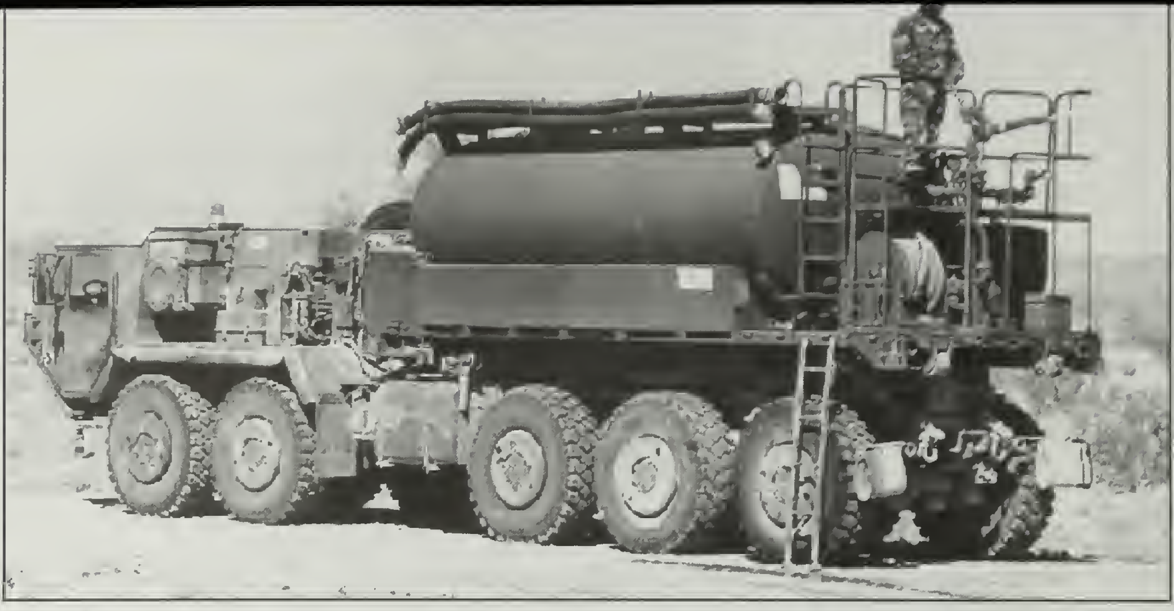
Concrete Mobile Mixer

The mixer can be used on the PLS truck or trailer or as a ground-mounted, stand-alone unit. In the transport mode, the capacity is five cubic yards, and in the stand-alone mode, the capacity is eight cubic yards. To accommodate stand-alone operation, an on-board diesel power supply provides all hydraulic, electric, and pneumatic power. Stand-alone operation is accommodated by four hydraulic legs that lift the flatrack off the ground and provide the clearance required to operate the mixer continuously. Two tanks with a total capacity of 460 gallons provide water for concrete production and cleanup. The water tanks can be loaded either conventionally or from a pond or stream with the on-board pump. Three extension chutes allow the concrete to be emplaced up to 12 feet away.

Dump Body

This equipment has a capacity of 12 cubic yards without sideboards and 14 cubic yards with sideboards. It can be operated from both the PLS truck and trailer. The body and tailgate are controlled from the cab. The PLS truck-mounted

The versatility of the PLS system with EMMs is depicted in this photo of the EMM concrete mobile mixer with PLS dump body. Upon arrival at the work site, the PLS truck can off-load the concrete EMM for stationary operation, then load the dump body from the trailer to perform dump operations.



The EMM water-distributor module is intermodal transportable and is powered by its own diesel engine. It has a 3,000-gallon, stainless-steel tank and is equipped with a self-loading, 600-gallons-per-minute pump unit. The water cannon's 175-foot spray range complements the 50-foot hose and nozzle.

UPIK provides power for the body. The bed is constructed of 0.250-inch-thick high-hard steel, and the headsheet and sides are of 7-gage steel. The tailgate is a combination of 7- and 10-gage steel.

Testing

After first-production unit hardware is delivered, developmental testing (DT) usually is completed before operational testing (OT) with soldiers in mission scenarios begins. Because the PLS chassis had already been fully tested and released, much of the normal automotive developmental testing was unnecessary. Developmental testing personnel saved both time and money by collecting their data during the operational testing phase.

Fielding of engineer mission modules is scheduled to begin in September 1999. Bituminous distributors will replace M918s one for one in construction support companies, combat heavy companies, and at the Engineer School. Concrete mobile mixers will replace M919s one for one in combat heavy companies, utility teams, port opening companies, and at the Engineer School. While not intended to replace a particular dump truck, dump bodies will displace two dump trucks in each utility team, six from each port opening company, and two from each construction support company.

The Future

What does the future hold for engineer mission modules? A water-distributor prototype unit has been produced and is currently being evaluated by soldiers. This unit has a 3,000-gallon capacity and would replace the M920 tractor and 6,000-gallon semitrailer-mounted unit. A water-distributor module on the PLS truck and one on the trailer would provide 6,000 gallons of nonpotable water in a highly mobile package. The water-distributor module could be configured for use in an auxiliary fire-fighting mission. Additional modules under consideration include a well-drilling rig, a mobile shop, a rock crusher, a mobile crane, and a water-purification module.

The EMM integrated process team is showing the engineer community what they can expect in the future by aggressively pursuing new and innovative contracting opportunities. We have taken that first critical step by streamlining the processes required to get the best equipment to soldiers in record time. Future efforts will focus on expanding on these successes to increase our visibility and utilization within the engineer community.

Mr. Motzenbecker serves as project leader on engineer mission modules and is the systems engineer on the PLS. He is Level III Acquisition Certified in Systems Planning, Research, Development and Engineering. Mr. Motzenbecker holds a bachelor's degree in mechanical engineering from Michigan Technological University.

Mr. Edgin is a project manager and technical lead for Science Applications International Corporation in support of the project manager for heavy tactical vehicles. He holds a master's degree in management from Walsh College of Business and Accountancy.

PERSCOM Notes

By Sergeant Major Teresa Fillmore

Due to recent changes in the Engineer Branch, there are several changes in the personnel who serve you. I will take this opportunity to introduce new members of the Engineer Branch at the Personnel Command (PERSCOM).

- Sergeant Major Theressa J. Fillmore, military occupational specialty (MOS) 75H, Branch Sergeant Major.
- Master Sergeant Harry Pomeroy, MOS 12Z, Professional Development Noncommissioned Officer (PDNCO), career management field (CMF) 12.
- Sergeant First Class Susan L. Fortune, MOS 81T, PDNCO and Assignment Manager, CMF 81.
- Sergeant First Class Andre Williamson, MOS 62N, PDNCO, CMF 51.

SGM Fillmore has an extensive 24-year background in personnel. She has served at company, battalion, brigade, corps, echelons above corps, and post levels, in both tables of distribution and allowances (TDA) and modified tables of organization and equipment (MTOE) units. She has held assignments with the Aviation, Signal, Military Intelligence, Engineer, and Air Defense Artillery Branches and the Recruiting Command. At the company, battalion, and brigade levels, she has served as the company clerk, Personnel Services (PS) NCO, and the Personnel Administrative Center (PAC) NCO in various locations. Her experience with engineers includes PSNCO and PAC supervisor for three years in a One-Station Unit Training battalion at Fort Leonard Wood. At the corps level, SGM Fillmore was the G1 sergeant major for V Corps Headquarters in Heidelberg, Germany, and deployed with Operation Joint Endeavor as the DCSOPS (FWD) sergeant major. At echelon above corps, she served on the U.S. Army Europe's DCSPER staff as a force structure NCO. At the post level, she was most recently the Adjutant General sergeant major at Fort Bliss, Texas. SGM Fillmore has attended all requisite leadership schools. She arrived at PERSCOM in May 1999 and expects to serve two or three years with the Engineer Regiment.

A Vietnam veteran of the First Cavalry Division, MSG Pomeroy re-entered the Army in 1982, serving in the 19th Engineer Battalion, Fort Knox, Kentucky. After completing an assignment with the 547th Engineer Battalion in Germany, he served with the 5th Engineer Battalion at Fort Leonard Wood, Missouri. He then returned to Germany and the 54th Engineer Battalion. Next he completed a tour as observer/controller at the National Training Center, Fort Irwin, California. He recently served as first sergeant, 588th Engineer Battalion, Fort Hood, Texas. MSG Pomeroy has served in Operation Desert Storm and has held numerous leadership positions as squad leader, platoon sergeant, engineer platoon trainer, and first sergeant. MSG Pomeroy arrived at PERSCOM in May 1999, ready to serve the Engineer Regiment.

SFC Fortune joined the Army in January 1983. After completing initial entry training at Fort Dix, New Jersey, and Fort Belvoir, Virginia, she was stationed at Fort Hood, Texas, as a cartographer. Later she transferred to the 29th Engineer Battalion, Fort Shafter, Hawaii. During this time she reclassified to terrain analysis and served for two years as a terrain analyst for the 25th Infantry Division (Light), G2 Terrain Team. She then returned to Fort Belvoir for four years as an instructor for the basic and advanced terrain analysis courses at the Defense Mapping School (DMS). During her last year at DMS, she also served as an air assault instructor. She attended Drill Sergeant School and successfully completed a two-year tour at an Advanced Individual Training company at Fort Belvoir. Her next assignment was in Hawaii for three years. During this time she served as platoon sergeant for the terrain platoon of the 70th Engineer Company, 29th Engineer Battalion. She spent two years as NCOIC of the 25th Infantry Division (Light) Terrain Team. SFC Fortune arrived at PERSCOM in January 1999 and plans to move on as a first sergeant after completing her tour.

SFC Williamson joined the Army in October 1979 as a cannon crewman. After a two-year tour at Fort Hood, he spent 27 months in Germany. Later he reclassified to a 62J general construction equipment operator at Fort Hood. He transferred to the 503rd Engineer Company in Germany for 26 months and then spent six years at Fort Benning, Georgia, with the 43rd Engineer Battalion (Heavy), serving as a section sergeant. During that tour he supported Operations Desert Shield and Desert Storm, Operations Restore Hope and Continued Hope in Somalia, hurricane relief missions in South Carolina and Florida, and a nation-building project in Costa Rica. SFC Williamson returned to Germany for four years with the 94th Engineer Battalion (Heavy), where he served as a platoon sergeant and battalion horizontal construction inspector. During this tour he spent 16 months deployed in support of Operations Joint Endeavor, Joint Forge, and Able Sentry. After completing a tour at PERSCOM, he hopes to be assigned as a first sergeant in a combat heavy battalion.

The staff at PERSCOM remains committed to providing excellent, professional service to the field. We are part of the engineer team and will work to make the Engineer Regiment more effective by placing the right people in the right places at the right time.

Sets, Kits, and Outfits: An Update

By Alan Schlie

This is the first of four articles on sets, kits, and outfits. This article focuses on tools for the construction trades; the second will concentrate on pioneer, mining, and demolition tools; the third on bridging, diving, lighting, and fire-fighting tools; and the fourth article will feature tools for technical specialties.

◆

The successful accomplishment of every mission is linked to one or more sets, kits, or outfits (SKOs) that contain the soldiers' tools of the trade. While the principal "tool" for every soldier is a weapon—rifle, pistol, howitzer, tank—numerous SKOs allow soldiers to perform individual tasks such as assembly, operation, maintenance, repair, packing, or lighting activities. Each weapon has a cleaning "kit," and if it is not used properly, the weapon doesn't function for very long.

Definitions

How do sets, kits, and outfits differ? A *kit* is a collection of tools or components in a small bag or pouch, designed for use and carried by an individual or a crew. For example, weapons have cleaning kits, and a mechanic's toolbox is a kit. A *set* is a collection of tools used by a group of soldiers (a squad, section, or platoon) to perform an organizational mission. A set may include tool kits but not other principal items of equipment that are assigned a line item number (LIN). The squad carpenter's set includes a file kit and a chisel kit. An *outfit* is an assemblage of tools or equipment that may include separately type-classified items as a component. A pneumatic tool outfit contains an air compressor and a trailer (separate major items) and numerous pneumatic hand tools, some of which have individual LIN identification.

The Engineer School is the proponent for 123 SKOs that include tools for topographic support systems, lighting, fixed and float bridging, general and topographic surveying, fire fighting, diving, railway construction and repair, electric power generation and distribution, demolition, mine laying and marking, pipeline construction, drafting, and materials testing. Other SKOs include hydraulic and electric construction tools; carpentry, masonry, electrical, and plumbing tools; and pioneer tools. The school works closely with various agencies in the Army Materiel Command to develop, document, and field SKOs. Rock Island Arsenal is currently fielding the hydraulic electric tool outfit. Tank-Automotive and Armaments Command at Warren, Michigan, is beginning a comprehensive review of all bridge sets. Communications-Electronics Command at Fort Monmouth, New Jersey, is the compiler for light sets and other sets containing electronic components. General Services Administration in Kansas City assembles all SKOs containing construction-related hand tools.

The Organization Branch of the Engineer Directorate of Combat Developments, which is responsible for developing and reviewing SKOs, began a five-year cyclic plan in 1998 to upgrade every SKO. Partnering with a commercial tool supplier has allowed the Engineer School to make several SKOs available for purchase at a time when the pace of unit deployments accelerates and the utilization of state-of-the-art tools speeds mission accomplishment. Field involvement and user testing in this developmental process ensures that tools meet soldiers' needs. In addition, regulatory guidance is being updated to include both generic and specific authorizations. This is necessary to add SKOs that were not included in the regulations and that units were hesitant to request. Regulatory guidance describes the SKOs, lists items needed to support them or that they support, and includes shipping characteristics.

Carpenter's Sets

As a result of the recent review of carpenter's sets, components were realigned, creating a stand-alone squad box of hand tools that is supported by increasingly versatile platoon boxes. The platoon boxes previously included seldom-used tools and extra handles or tools for special applications. Because of the review, some hard-to-maintain tools were replaced by tools that are more commonly used by the construction industry today.

The **Squad Carpenter's Set** still contains nonpowered hand tools. New items include speed squares; heavy-duty tool belts; heavier, waffle-faced framing hammers; shingling hammers; taping knives; and a nut driver kit. The set weighs 120 pounds and is packed in a 9-cubic-foot transport case.

The **Platoon Carpenter's Set** has saws and drills powered by 18-volt batteries. The set is completely reconfigured with 5 3/8-inch trimcut saws;1/2-inch variable speed, reversing drill/driver/hammers; a reciprocating saw; a jig saw; and numerous drill bits and saw blades. The set weighs 130 pounds and is packed in a 12-cubic-foot transport case.

The **Trailer-Mounted, Woodworking, Base Maintenance Shop Equipment Set** contains electric saws and drills and pneumatic nailers. The set consists of three subkits, each in its own transport and storage box and designed to fit on the trailer with the 10-kilowatt generator.

The *Table Saw and Router Kit* consists of a 10-inch portable table saw and stand; a plunge router; a jig saw; and blades, bits, and extension cords. This kit weighs 300 pounds and is packed in a 20-cubic-foot transport case.

The *Multisaw and Drill Kit* contains a 12-inch miter/compound saw; a 14-inch circular chop saw; a 10 1/4-inch circular saw; a 7 1/2-inch circular saw; a reciprocating saw; 1/2-inch drive variable speed drills; an electric shear/nibbler; and various clamps, blades, bits, countersinks, and circle cutters. This kit weighs 335 pounds and is packed in a 20-cubic-foot transport case.

The *Pneumatic Nailer and Compressor Kit* consists of an electric, 2-horsepower air compressor; two pneumatic framing hammers; nail pullers; 150 feet of air hose; a moisture separator; couplers; and extension cords and nails. This kit weighs 315 pounds and is packed in a 13-cubic-foot transport case.

Platoon Carpenter's Set

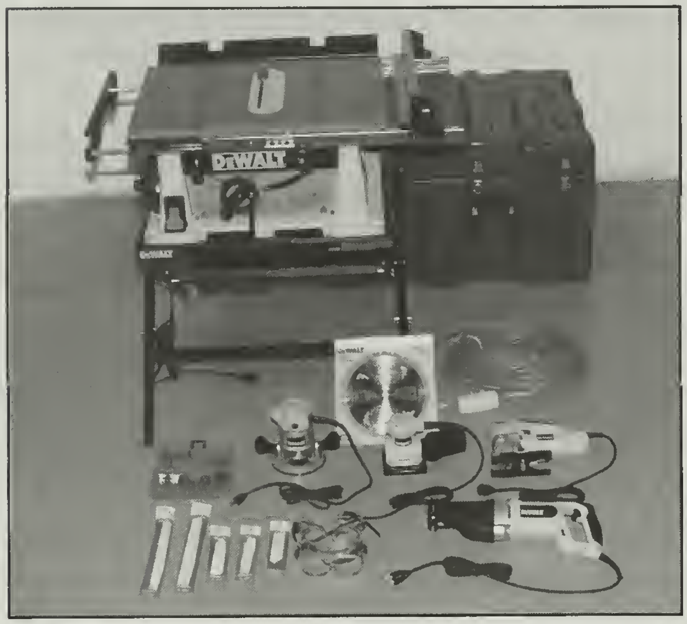
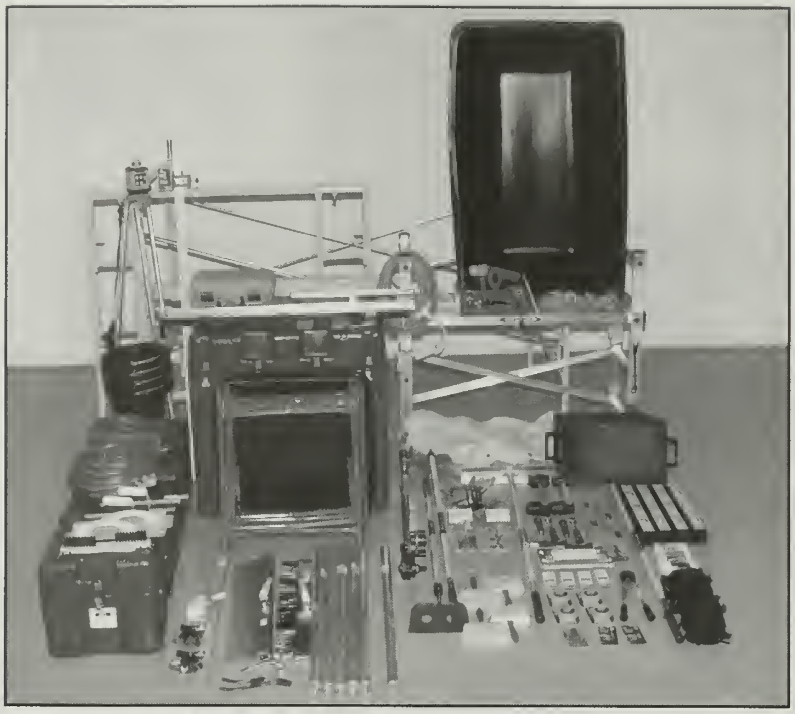


Table Saw and Router Kit

The **Mason's and Concrete Finisher's Tool Set** has been reconfigured to support a platoon, with enough individual tools for six soldiers to lay block or brick. Twenty-four feet of interchangeable, sectionalized handles fit the brooms, screeds, and floats, enabling the components to fit into the transport case. The set includes mortar pans, boards, and stands; various floats, edgers, and trowels; knee boards; buckets; a rebar cutter/bender; a side wheel grinder; mason's shovels and hoes; hand pump sprayers; a laser level; and buckets, nozzles, and garden hoses. New additions are a 3-cubic-foot-capacity, gasoline-powered mortar-mixing machine; 16-foot ladders; 12-foot collapsible ladders; 3-foot-high portable stands; and four sections of 5-foot-high by 8-foot-long scaffolding, with walk boards and casters.

The **Electrician's #1 Tool Set** will continue to support squad-level electricians with the latest in protected hand tools. Included in the upgraded set are an 18-volt cordless saw, a drill/driver/hammer, a reciprocating saw, a snake light, a right-angle drill, a tool set with various circuit-testing devices, lockouts and padlocks, work belts, a laser level, fish tape, a bounce light, flood lights, extension cords, and a site box. The normal assortment of saws, chisels, hammers, benders, blades, strippers, sockets, hex keys, and wrenches have been retained in upgraded motif.



Mason's and Concrete Finisher's Tool Set

The **Pipefitter's 1/8-Inch- to 2-Inch-Diameter Pipe Tool Kit and Pipefitter's 2-1/2-Inch- to 4-Inch-Diameter Pipe Tool Kit** have been combined into a single set that is allocated to the platoon. There's an assortment of pipe wrenches, cutters, and reamers; a hand-driven and electric die head-threading machine; a tristand chain vise; powered drain cleaners; recycling oiler; heat gun; propane torch kits; a bounce light; and flood lights. The normal complement of pliers, screwdrivers, pry bars, chisels, levels, work belts, flux, solder, PVC fixative, Teflon tape, extension cords, and job site box are provided. This set is in its final stages of development.

Safety equipment provided in each box includes ultraviolet eye protection, antifog goggles; ground fault circuit interrupter surge protectors; dust masks; and rubber hand guards on chisels. Carpenter hammers and hatchets have steel handles, and handles on other hammers have a black plastic covering over a fiberglass core. This is a recently patented process by NUPLA Corporation that increases comfort and reduces stress to users' arms.

New transport and storage cases represent the latest in manufacturing. The cases are rotationally molded of high-quality polyethylene resins to military specifications. They are resistant to solvents and acids. The color is molded in, so they never need painting. The edges are rounded to reduce the risk of injury. They are stackable and can be loaded or moved by forklift. They are airtight to keep out dirt and moisture, can be decontaminated, and are recyclable. The handles are high-strength, high-density polyethylene that is unaffected by common fuels or solvents. They are recessed and spring loaded to stay out of the way. And they offer a grip that's comfortable and big enough to easily accommodate a gloved hand. Noncorrosive, nonreflective metal catches, hinges, and strikes are placed in recesses to prevent being sheared off during rough handling. Stainless steel inserts are molded in to give catches, hinges and strikes added strength.

The tool sets developed so far have been used successfully during deployments to Mongolia, Bangladesh, Thailand, and Honduras by combat heavy units from Hawaii, Fort Lewis, and Fort Polk. Eventually, the sets will be issued to all units, but for now they must be purchased with operational funds.

The good news is the warranty on the tools. Any tool that becomes inoperable or presents a safety hazard through "fair wear and tear" will be replaced at no charge. GSA and the tool supplier have created 1-800- telephone numbers to facilitate the exchange. The bad news is in fielding the sets. Current regulatory guidance requires units to purchase upgrades to SKOs with their operational funds. The Engineer School has chosen to make the SKOs available for units to purchase until fielding plans and alternate funding programs are developed. National stock numbers (NSN) for the new tool sets will be rolled under the SKO's LIN, because it is the LIN that is authorized in the modified table of organization and equipment, not the NSN. This would eliminate the requirement for units to maintain both boxes.

Summary

A future article will discuss the Pioneer Tool Sets currently being reviewed, and we expect that there will be substantial changes. Input from users is strongly encouraged. Get involved, and make your tool sets work for you.

Send your ideas and comments to the Director of Combat Developments, Engineer Division, Organization Branch (Tom Knotts or Alan Schlie), 320 Engineer Loop, Suite 141, Fort Leonard Wood, Missouri 65473. Telephone numbers are commercial (573) 563-6191, DSN 676-6191, and fax (573) 563-4089/5056. The e-mail address is schliea@wood.army.mil.

Mr. Schlie is a force development analyst with the Directorate of Combat Developments, U.S. Army Engineer School. A retired command sergeant major, he has served in various capacities in Europe, Korea, and CONUS throughout his career.

OBSTACLE COORDINATION POINTS

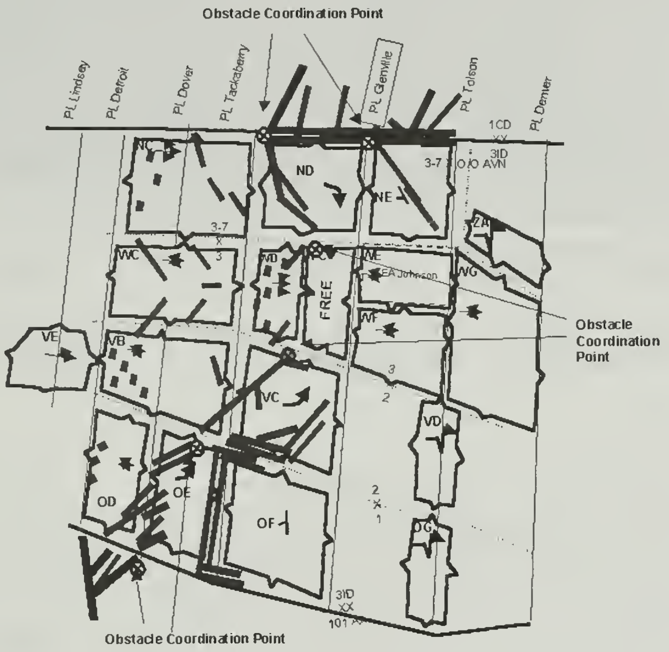
By Colonel David W. Washechek, Lieutenant Colonel James A. Price and Captain Kevin Pettet

Although obstacle coordination points are not current doctrine, this article describes a tactic, technique, and procedure that engineers in the XVIII Airborne Corps found useful during the 3rd Infantry Division Warfighter Exercise at Fort Stewart, Georgia, on 7-12 February 1999.

The XVIII Airborne Corps developed a Corps-level obstacle plan with designated *obstacle coordination points* in support of the Corps maneuver plan. By doing so, XVIII Airborne Corps engineers ensured coordinated obstacle effort throughout the Corps sector, which enabled the Corps to shape the battlefield and fight one fight with massed combat power. In doing so, XVIII Airborne Corps forced the World Class opposing forces into Corps- and division-level engagement areas where they were easily destroyed.

The doctrinal foundation for an obstacle coordination point is found in the definition of a *coordinating point* in FM 101-5-1, *Operational Terms and Graphics*: a control measure that indicates a specific location for the coordination of fires and maneuver between adjacent units. The engineer interpretation of a coordinating point is a place where leaders coordinate their obstacle effort across division and Corps boundaries in support of the maneuver plan.

An obstacle coordination point is not a point on the ground that dictates exactly where obstacles are tied in, but rather a graphic-control measure. These points can be established at Corps, division, brigade combat team, or task force levels. At the Corps level, obstacle coordination points are established along boundaries (flanks) between divisions. At the division level, they are established along boundaries (flanks) between maneuver brigades.



The Corps established two obstacle coordination points on 3rd Infantry Division's northern flank and one on its southern flank, with the intent to turn the enemy into 3rd Infantry Division's sector. In turn, the 3rd Infantry Division established three obstacle coordination points within its sector with the intent to turn the enemy from the flanks into the center sector. These points helped leaders ensure that all obstacles along division flanks were coordinated and emplaced so no gaps existed in the plan. The obstacle coordination points reinforced the commander's intent and synchronized the obstacle effort across the entire sector.

The XVIII Airborne Corps used obstacle coordination points to help the commander communicate his intent during defensive operations. They supported the commander's description of how he wanted to shape the defensive battlefield space, ensured synchronicity of obstacle effort and covering fires, and accelerated leader involvement.

Established obstacle coordination points prevented seams in the obstacle plan (between sectors/boundaries) and eliminated the need to "redesign" portions of the obstacle effort. This saved the Corps, division, and brigades time, manpower, and material resources.

Colonel Washechek commands the 3d Infantry Division's Engineer Brigade. A graduate of the United States Military Academy, he holds a master's degree in civil engineering from Brigham Young and is a registered professional engineer in Virginia.

Lieutenant Colonel Price is the Assistant Corps Engineer, XVIIII Airborne Corps. He is currently deployed to the EUCOM AOR and is serving as the Branch Chief, J3 JOPES Support Element.

Captain Pettet is the XVIII Airborne Corps Engineer Plans Officer. He is a graduate of the U.S. Military Academy, the Air Assault and Airborne Schools, the Engineer Officer Advanced Course, and CAS3 and holds a master's degree from the University of Missouri-Rolla.

INSTRUCTING AT THE U.S. MILITARY ACADEMY... MORE THAN JUST TEACHING CADETS

By Major R. Mark Toy

You have just completed company command and have spent your entire Army career "with troops." One option for your next assignment is advanced civil schooling with a follow-on assignment to the United States Military Academy. If you choose this option, consider the Department of Geography and Environmental Engineering (D/GEnE), which provides numerous opportunities to further develop engineer officers. Although your primary task will be instructing, the benefits of an assignment in the D/GEnE extend far beyond teaching.

Applying for a Position

The department head and program directors review the files of all applicants for instructor positions. Those selected attend a fully funded graduate school for two years of concentrated study in an environmental engineering; mapping, charting, and geodesy (MC&G); or geography program. Although applicants may voice a desire as to the school they attend, the department head and appropriate program director make the decision. After graduation, applicants report to West Point in the summer and prepare to teach during the fall semester.

Programs

Engineer officers in the D/GEnE at West Point instruct in one of the following programs:

- **Environmental Engineering** instructors teach either core courses or electives. Core courses are *Introduction to Environmental Engineering, Environmental Systems Analysis,* and *Environmental Systems Design*. Elective courses include *Hydrogeology, Water Resources Planning and Design, Solid and Hazardous Waste Management,* and *Meteorology and Air Pollution*.
- **Mapping, Charting, and Geodesy** is becoming the most popular course of study in the D/GEnE. Courses include *Remote Sensing, Cartography, Photogrammetry, Surveying, Geographic Information Systems,* and *Descriptive Astronomy.*
- **Geography** offers such challenging courses as *Cultural and Political Geography; Foundations in Geography; Military Geography;* and *Geography of Russia, Asia, Latin America, Middle East and Africa, North America, and Europe.*

First-year instructors in the D/GEnE teach the department's core course, *Terrain Analysis*, during their first semester. Required for all sophomores, the course provides basic knowledge of the earth and environmental sciences. Students also learn to conduct comprehensive terrain analyses at area or local levels using atlases, maps, remotely sensed imagery, and geographic information systems. Teaching *Terrain Analysis* provides excellent opportunities to interact with young cadets who will soon select an academic major. Instructors can demonstrate to them the value of a degree in the geographic or environmental sciences.

Concurrently, or by the second semester, instructors begin teaching courses in any of the three D/GEnE programs. By the end of the second and into the third year, instructors become the director of one or more courses. The director updates course content, mentors junior faculty, and handles

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administrative duties. In the final year of their assignment, instructors become assistant professors of their respective discipline.

Being an instructor in the D/GEnE involves much more than teaching, and these "other-than-teaching" opportunities set an assignment here apart from other Army nontroop assignments. Nonteaching duties not only offer an opportunity to participate in cadet development but also help with officer development. Where else can an engineer officer acquire a professional engineering (PE) license, teach military science and land navigation, and help influence top-notch lieutenants to join the Corps of Engineers?

West Point cadets learning proper land navigation techniques.

Acquiring a PE License

West Point instructors from the Engineer Branch are well on the way to getting a PE license. All states require some engineering experience as a prerequisite for obtaining a PE license. By virtue of their branch and number of years served in the Army, D/GEnE instructors already have most of the necessary years of experience required in many states. One year in graduate school and teaching time at USMA also count as engineering experience. License applicants must state all their experience, and a good place to start is with the job description of their officer evaluation reports.

In preparing for the PE examination, particularly for the examination in environmental engineering, the D/GEnE is a good place to be. Both the department head and the environmental engineering program director hold doctorate degrees in environmental engineering and are registered professional engineers. Moreover, the department head has a Diplomate in Environmental Engineering certificate. His duties include serving as vice chairman of the Environmental Engineering Exam Committee for the National Council of Examiners for Engineering and Surveying. About three-fourths of the West Point environmental engineering rotating faculty are licensed professional engineers. The rest are engineers-in-training, or are preparing to take the exam within the next year. *Note: To take the PE examination, applicants must have already passed the Fundamentals of Engineering Exam and have been designated an engineer-in-training.* Instructors at West Point are surrounded by capable engineer officers who are more than willing to answer questions and help them prepare for the PE examination. By the end of a three-year assignment, engineer officers can depart from West Point with a professional engineer license.

Teaching Military Science

The United States Military Academy follows a two-semester academic year. Between the first and second semesters is a two-week period in January called *military intercession*, when cadets receive military science instruction. Freshmen receive instruction in map reading and troop-leading procedures. Sophomores and juniors study *Combined Arms Operations 1* and *2*, respectively. Seniors, who will soon be commissioned second lieutenants, take a class called *Tools of the Trade and the Leader's Legal Role* to prepare for the challenges they will face as platoon leaders.

Most of the officers at West Point are assigned to the dean's office and provide instruction for military intercession. In the D/GEnE, officers teaching military science classes have an outstanding opportunity to share their experiences as an engineer company commander, platoon leader, and staff officer to young lieutenants-in-training. It is also an opportunity to stay connected to the Engineer Branch. Many cadets will soon choose a branch, and military science instructors can introduce them to the Corps of Engineers.

Teaching Land Navigation

Unique to the D/GEnE is the annual summer task of instructing the sophomore class in the art of land navigation. This training period is an excellent opportunity for officers to return to their Army roots and "get back with troops." With the assistance of soldiers and noncommissioned officers from the active Army (typically the 10th Mountain Division), the department provides training for approximately 1,000 cadets over a three-week period. The D/GEnE teaches basic and advanced land navigation skills under day and night conditions. As an officer-in-charge of one of three land navigation sites, instructors completely control the set-up and execution of land navigation training. Their instruction is most important to these junior leaders, who must be proficient in this critical Army task as platoon leaders.

Selecting a Branch and Post

One of the most rewarding experiences for an instructor at the USMA is participating in the cadet branch and post selection process. An Engineer Branch representative (a major or lieutenant colonel) is assigned to the academy in the Department of Military Instruction. This engineer officer coordinates the branch and post selection process for all seniors who select the Corps of Engineers as their branch. The Engineer Branch representative typically solicits assistance from all engineer officers at West Point. As representatives of the Corps of Engineers, USMA engineer instructors provide valuable information to the Army's future engineer lieutenants. Branch selection is one of the most important decisions that cadets will make in their military careers, and most of them are eager to learn about officers' experiences in engineer units. After cadets select the Engineer Branch, they choose the location of their first three-year assignment. Once again, the experiences of an engineer officer will be valuable to the cadets as they select a post. The bottom line is that as engineer officers, we have a vested interest in finding the very best second lieutenants to join our ranks. As part of the D/GEnE, engineer officers have a direct impact on future engineer platoon leaders who may someday serve in their battalion.

The Right Choice for You!

An assignment in the D/GEnE at West Point will be one of the most challenging and rewarding experiences of your Army career. As a member of the faculty, your responsibilities and opportunities to excel go far beyond teaching cadets. Not only will you become a better officer intellectually, you will continue to hone your military skills. Most importantly, you will help shape the lives of the young men and women who join the Corps of Engineers and lead our Army into the 21st century.

For more information about joining the faculty in the D/GEnE at West Point, call the personnel officer at commercial (914) 938-3321 or DSN 688-3321.

Major Toy, an Assistant Professor of Environmental Engineering in the D/GEnE, will attend Command and General Staff College this summer. Previous assignments include company commander and assistant S3, 864th Engineer Battalion, Fort Lewis, Washington. MAJ Toy is a graduate of the U.S. Military Academy and holds master's degrees in environmental engineering from UCLA and business administration from Boston University. He is a registered professional engineer in Virginia.

(Continued from page 31)

State vs. Status

The term "state" refers to the *capability* of mobility/survivability assets in terms of what we can provide to support the task force's mission. Instead of simply regurgitating the assets available, the planner should brief the commander on precise engineer capabilities. For example, state the number of breach lanes, number of protective positions, linear meters of obstacle effort, etc., that engineers can provide and as required estimates of what the task force as a whole could provide if necessary. *Status* is simply how many widgets we have. The maneuver commander does not care how many widgets we have; he wants to know if engineers can support the mission and, if not, what additional tasks must be completed or what additional assets must be acquired. Ask yourself "Why am I telling the commander this?" The engineer planner must ask himself "So what? What does my analysis, this processed information that I am about to share with my commander or fellow members of his staff, mean to the task force as a whole?" He must provide that information in terms that are useful to the commander. Don't say "Sir, I have four of six dozers operational. I will be followed by the Air Defense Officer." Instead, say "Sir, I have four of six dozers operational, and with those assets I cannot achieve your required level of survivability for the task force by the No Later Than Defend Time. My recommendation to overcome this shortcoming is to…"

Conclusion

The EBA is the foundation of all engineer planning and the basis of engineer integration in the combined-arms team. However, engineer planners routinely exclude the preparation of an EBA when they conduct a mission analysis. A detailed EBA must be prepared to provide the information required for units to be successful during mission analysis and subsequent planning activities for the task force.

Future articles by the JRTC observer/controller team will address specific tactics, techniques, and procedures for the EBA and planning tools we have seen units use successfully at the training center.

Major Baker served as the Senior Engineer Company Observer/Controller at the Joint Readiness Training Center, Fort Polk, Louisiana, when this article was written. He currently is the CTC Branch Chief, Center for Army Lessons Learned, at Fort Leavenworth, Kansas. Previous assignments include brigade engineer, assistant battalion S3, and commander, B Company, 326th Engineer Battalion, 101st Airborne Division (AASLT); assistant brigade S3, 2nd Infantry Division, Camp Howze, Korea; and platoon leader and company executive officer, 37th Engineer Battalion, (CBT)(ABN), Fort Bragg, North Carolina.

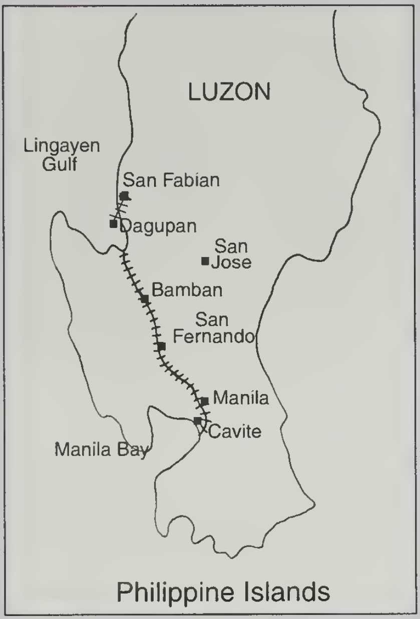
Engineers in the Philippines a Century Ago

By James W. Dunn

When the United States declared war on Spain on 25 April 1898, the cry was "On to Cuba," and the War Department immediately began assembling Army units in Florida in anticipation of a land campaign that ultimately would include Puerto Rico as well as Cuba. While Companies C and E, Battalion of Engineers, headed for Tampa, a naval battle halfway around the world resulted in other engineer units deploying to California for another land campaign—this one in the Philippine Islands. Thus, the Spanish-American War, initially seen as a crusade to free the Cuban people from harsh Spanish rule, became a two-ocean war, which would eventually involve the Americans in operations against newly liberated Filipinos.

On 1 May, Commodore George Dewey's U.S. Navy Asiatic Squadron defeated a Spanish flotilla in Manila Harbor, but he knew that ground forces would be needed to take the city of Manila. Emilio Aquinaldo, leader of the Republic of the Philippines, had 12,000 Filipino irregulars besieging the city, but he could not hope to successfully attack the 13,000 Spanish regulars defending it. An American Army force was needed for such an attack.

As Major General Wesley Merritt organized the U.S. Army's VIII Corps in the San Francisco area in preparation for movement to the Philippines, Company A, Battalion of Engineers, commanded by Additional 2d Lieutenant William D. Connor, left New York City by railroad for San Francisco to join the VIII Corps. General Merritt sent his force to the Philippines in three expeditions. The first left without engineers on 25 May, but Lieutenant Connor and a detachment of 20 enlisted engineer soldiers accompanied the second expedition when it left on 15 June. The third expedition left on 27 June with the rest of Company A and arrived at Cavite, in Manila Harbor, on 1 August.



By that time, Connor's detachment had moved forward from Cavite to Camp Dewey, just three miles south of Manila. Lieutenant Connor conducted a reconnaissance of the Spanish lines and made a rough topographic map. He then put his engineers to work building portable trestle bridges to cross San Antonio Creek in front of the Spanish lines. By the time the rest of Company A arrived at Camp Dewey on 7 August, the plan of attack and the engineers' role in it were in place.

General Merritt organized his attack force into a division commanded by Brigadier General Thomas M. Anderson, with two infantry brigades under Brigadier Generals Francis V. Greene and Arthur MacArthur. Merritt planned to advance the two brigades north astride the road from Camp Dewey to Manila with newly promoted Rear Admiral Dewey's squadron providing cannon and machine-gun fire against the Spanish defenses. Greene's force, with Connor's platoon in support, would have its left flank on Manila Bay, while MacArthur, with 1st Sergeant James Reardon's platoon supporting, was to move forward on the right of the road. The Spanish, realizing their difficult position, had agreed to surrender after a show of force, but the Americans were uncertain about how much of a show of force they could expect.

The two brigades attacked at 0930 on 13 August through gaps the engineers had cut in defensive wire under cover of darkness. Engineers accompanied the first troops into Manila, repairing bridges and destroying field fortifications along the route of advance. It was all over by 1130.

A U.S. Army engineer ferry in the Philippines, in 1899.

U.S. Army engineers retrieve an engine that insurgents had run off a washed-out railroad bridge near Angeles, Philippines, in 1899.

The Spanish troops were defeated, but a threat from another source hovered over Manila as the engineers got busy cleaning up a city surrounded by Filipino irregulars eager to reap the rewards of the Spanish defeat. But the Filipinos gradually realized they had traded Spanish rule for American rule. As the Americans took over, General Merritt put Lieutenant Connor in charge of the city's water-supply system, while Sergeant Thomas F. Kennedy led a detachment of 20 enlisted men to clear the Pasig River for navigation. Engineers also reconnoitered and surveyed the city and immediate surrounding areas, including positions occupied by Aguinaldo's Filipinos. On 29 January 1899, Aguinaldo arrested Sergeant Henry L. Fisher and his four-man engineer detachment when their reconnaissance took them into the Filipino lines. They were released unharmed on 3 February, but the next day a battle erupted between the American and Filipino forces. The Philippine Insurrection had begun.

On 28 March, the Americans, knowing they were not strong enough to defeat Aguinaldo, began a drive north along the railroad to San Fernando to gain time and operating room and to await reenforcements. Engineer 2d Lieutenant William P. Wooten and a 25-man detachment from Company A supported the drive, repairing the railroad and building bridges and rope ferries over rivers. MacArthur arrived in San Fernando on 5 May and ordered operations to stop for the duration of the rainy season. When Captain William L. Sibert's Company B, Battalion of Engineers, arrived in Manila on 10 August, the Philippine Command formed the engineers into a provisional battalion of two companies. Meanwhile, the Americans built up ground troops in preparation for an offensive.

In the fall, near the end of the rainy season, the Americans began a three-pronged drive north toward Lingayen Gulf. MacArthur attacked along the railroad toward Dagupan, while Brigadier General Henry W. Lawton's cavalry heavy force protected the right flank with a drive through San Jose toward San Fabian, and Brigadier General Lloyd Wheaton conducted an amphibious assault at San Fabian. On 5 November, engineer Lieutenants Sherwood Cheney and Horton Stickle, with a detachment of 20 enlisted men from Company A, departed Manila aboard the troop ship *Aztec* as part of an amphibious assault force. While some of those engineers unloaded men, supplies, horses, and mules from transport ships anchored a mile offshore in Lingayen Gulf, others cleared the beach of obstacles, opened access roads, and repaired bridges along the route of advance inland. Meanwhile, Lieutenant John C. Oakes, with a 40-man detachment from Company B, supported the cavalry drive by repairing roads and bridges, and Captain Sibert led the rest of Company B in supporting MacArthur by putting the railroad into operation as part of the line of communication.

By mid-December, Aguinaldo's Filipinos were defeated as a conventional force, and the Americans thought the war was over. But they soon realized that, while the conventional war was over, a different type of war had begun. The Filipinos simply melted into the hills to conduct guerrilla operations against the Americans for several years into the new century. Finally subdued in the years before World War I, the Filipinos became staunch American allies in World War II. In that war, two more amphibious operations took place in Lingayen Gulf: one when the Japanese attacked the Philippines in December 1941, and another when General Douglas MacArthur's American troops returned in January 1945. The Philippines gained independence from the United States in 1946, and today the two nations have mutual interests in the western Pacific.

* * *

Additional Reading

Andrew J. Birtle, *U.S. Army Counterinsurgency and Contingency Operations Doctrine, 1860-1941*; U.S. Army Center of Military History, 1998, 319 pages.

Graham A. Cosmas, *An Army for Empire;* White Mane Publishing Company, 1994, 349 pages.

* * *

Dr. James W. Dunn is a historian in the Office of History, U.S. Army Corps of Engineers, Alexandria, Virginia.

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Maneuver Support Center (MANSCEN)

Fort Leonard Wood Reunion. The Ozarks-based Army post is having a reunion, and everyone who has ever trained or served here is invited back for a visit.

Fort Leonard Wood officially becomes the Maneuver Support Center (MANSCEN) on 1 October 1999 and will assume responsibility for training military police and chemical defense specialists as well as continue the mission of training engineers and basic training soldiers. More than $220 million has been spent on improvements to the post, which received the additional training missions after Fort McClellan, Alabama, was ordered to close in 1995.

Activities will be held throughout the week of 26 September through 1 October and will culminate in an activation ceremony and open house on Friday. More information will be published as the event draws near.

POCs are MAJ Mark Rodwell and CPT Mark Cheadle, -6150.

Directorate of Training Development (DOTD)

Field Manual Update. The following field manuals (FMs) are scheduled for publication:

- FM 5-34, *Engineer Field Data*, and FM 20-3, *Camouflage, Concealment, and Decoys*, are at the Army Training Support Center (ATSC) awaiting printing. Both manuals are posted to the Engineer School's Publications Page: http://www.wood.army.mil/PUBS/newpubs.htm).
- Change 1 to FM 20-32, *Mine/Countermine Operations,* and Change 1 to FM 5-250, *Explosives and Demolitions*, also are at ATSC awaiting printing. These changes bring Army doctrine in compliance with the United Nations Convention of Certain Conventional Weapons (CCW) mandate that all fragment munitions produce fragments that are visible by X-ray (such as metal or rock). These changes are posted to the Engineer School's Publications Page at the above web address. Printed copies will be dated 30 June 1999.
- FM 20-11, *Military Diving*, dated 20 January 1999, has been distributed to field units. It is available on the Army Doctrinal Training Digital Library at *http://155.217.58.58/atdls.htm*.

The following manuals are scheduled for publication and release to the field within the next 180 days:

- FM 5-436, *Paving and Surfacing Operations*
- FM 5-434, *Earthmoving Operations*
- FM 5-472, *Materials Testing*

POC is Sandra Gibson, -4100.

Total Army School System (TASS) Battalion Schools. The Engineer School recently completed three distance-learning CD-ROMs for the 51B10 (Carpentry and Masonry Specialists)

Reclassification Course. These CD-ROMs will be Phase I of the new Total Army Training System (TATS) Course. Soldiers must complete the CD-ROM portion of the course prior to completing the Inactive Duty Training (IDT) (Phase 2) and Active Duty Training (ADT) (Phase 3) portions of the course. Topics covered include base mathematics, measuring devices, construction drawings, carpentry tools, and masonry tools. The CDs will replace about three days of resident instruction. The planned date of implementation to TASS battalions is 1st quarter, FY01. The Engineer School's Multimedia Division currently is working on the distance learning portion of the 63E10 Reclassification Course.

POC is Terry Tapp, -4116

Directorate of Combat Developments (DCD)

New Tool Kit for Maintenance Personnel. The Tool Kit, Crimping, will be added to Hydraulic Systems Test and Repair Units (HSTRU). The lightweight tool is hand-operated and requires no power source. Because it allows hydraulic hose to be repaired on the spot rather than replaced, the kit saves down time and trips to the motor pool. The kit includes a 4-inch caliper; a hose-end holder; and a durable, compact carrying case. Units may purchase the Tool Kit, Crimping, using NSN 5180-01-458-6737; the cost is $306.52.

POC is SSG Joseph Malong, -7236.

Tool Kit, Crimping

Mobile Field Lavatory System. Field sanitation is a concern for every commander. Units should check out the Mobile Field Lavatory System's web site at *http://www.briefrelief.com* for items that will allow soldiers' needs to be met in the field and during deployments. The site lists several NSNs for products that meet federal and state requirements and have been tested and approved by all military branches.

POC is Alan Schlie, -6191.

News and Notes

Engineer Officer Candidate School (OCS) Reunion. All officer candidate classes, World War II through the present, are invited to Engineer OCS Reunion 99. It will be held at Fort Leonard Wood and Lake of the Ozarks, Missouri, 27-31 October 1999. The reunion is for former OCS candidates; staff and faculty of the Engineer Officer Candidate School, U.S. Army, Fort Belvoir, Virginia; and alumni of branch and branch immaterial officer candidate schools who later commissioned engineer. The reunion is an activity of the forming OCS Association, which is collecting and preserving OCS historical material and recording lessons learned.

POC is Thorpe Mealing, (404) 231-3402.

Lead the Way

By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School

Safety

As professional officers, noncommissioned officers, and soldiers, we learn from the first day of Army training to make safety and good safety practices part of everything that we do. We are taught that nothing is more important than safety. The key to working safely is good risk assessment and risk management. The Maneuver Support Center's Safety Office, at Fort Leonard Wood, has prepared a superb tool to assist with your units' risk assessment and risk management program—the *MANSCEN Risk Management Toolbox* CD-ROM. A partial list of items included on the CD-ROM follows:

Booklets

- Commanders and Staff Risk Management Booklet
- Small Unit Risk Management Booklet

Cards

- Copy Ready Leaders Card
- Copy Ready Program Card
- Example Leaders Card
- Example Program Card
- MANSCEN Heat Index Card
- MANSCEN Wind Chill Card

Example Briefing Materials

- Course Of Action Briefing
- Example Battle Update Briefing
- Example Risk Management Program Briefing
- MANSCEN Motor Vehicle Risk Briefing
- Operational Versus Accidental Risk Briefing
- Risk Management Briefing, Formats No. 1 Through No. 3
- Senior-Level Officer Professional Development Briefing

Example Policy Memorandum

- Example Policy Letter

Example Regulation

- Fort Leonard Wood Regulation 385-5
- Example Safety Annex

Example Work Sheet

- Deliberate Risk Assessment Work Sheet

Copies of the CD-ROM are available upon request. In addition, the MANSCEN Safety Office has a useful family safety training package for use with the Family Support Group Safety Training Program. The package contains a Powerpoint slide briefing that addresses summer and fire safety. The briefing includes view graphs, notes, and a script. There is also a 3 1/2-inch computer disk that contains all the materials. This is a world-class safety tool for families.

These safety tools are available from the Maneuver Support Center Safety Office. Call Mr. Fred Fanning at (573) 596-0116 or DSN 581-1275. His e-mail address is fanningf@wood.army.mil. The Safety Office's fax number is (573) 596-0017. These products are also available at the MANSCEN safety web page. The address is *http://www.wood.army.mil/safety.*

Engineer Command Sergeants Major Training Conference

Final plans are underway for this year's fall Engineer Command Sergeants Major Training Conference. It will be held in the Washington, D.C., area during the period 25-29 October 1999. This informative conference will focus on new engineer doctrine, training, equipment, force structure, and the Noncommissioned Officer Education System (NCOES). Many special presentations will be conducted, in addition to a staff ride at the Antietam Battlefield. The conference is open to all engineer command sergeants major from all components. The Engineer School's Engineer Personnel Proponency Office is responsible for planning and conducting this conference. To provide conference information, a special web site will be established on the Fort Leonard Wood Home Page at *http://www.wood.army.mil*. Check it out.

New Engineer School Command Sergeant Major

CSM Arthur D. Laughlin, 130th Engineer Brigade, Hanau, Germany, has been selected as the Engineer School's new command sergeant major. CSM Laughlin has more than 28 years of service and has served at every level of NCO leadership, from squad leader to brigade command sergeant major. CSM Laughlin's extensive experience will be a tremendous asset to the Engineer School and the Engineer Regiment. He will report to Fort Leonard Wood by the end of August.

Command Sergeant Major, 3rd Infantry Division

CSM George Ruo, an engineer command sergeant major, recently was selected to be the Command Sergeant Major, 3rd Infantry Division, Fort Stewart, Georgia. CSM Ruo joins CSM Harold Montgomery, 1st Infantry Division, as an engineer serving as a division-level command sergeant major.

Congratulations to these two great engineer senior leaders!

Integrity

"A man of character in peace is a man of courage in war."
Lord Moran, "Anatomy of Courage" - 1945

Brigadier General William Ludlow

Brigadier General Ludlow was a distinquished engineer, explorer, and soldier. He received three commendations for bravery in the Civil War. Later in his career, while on leave of absence from the U.S. Corps of Engineers, he was Chief Engineer in the Water Department of Philadelphia. One day a factory owner, used to getting more than his share of water for his factory, walked into Ludlow's office. The visitor handed Ludlow a $50 bill so that he could "buy cigars for his boys." To show his contempt, Ludlow took out one of his own cigars and offered his visitor another. He then folded the $50 bill, lit it with a match, and used it to light his own cigar and that of his visitor. When the bill had been reduced to ash, Ludlow asked his visitor how he liked the cigar.

History Office, U.S. Army Engineer School

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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

November 1999

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AT URBANA-CHAMPAIGN

Engineers in Kosovo

Headquarters, Department of the Army
PB 5-99-4 Approved for public release, distribution is unlimited.

CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

MANSCEN is now part of our chain of command. A week of events (27 September-1 October) marked the formal beginnings of the Army's Maneuver Support Center and the subordination of the Engineer School to MANSCEN. We engineers now live and train with the MP Corps and the Chemical Corps here at Fort Leonard Wood. I welcome Colonel (P) Ronald L. Johnson as the Assistant Commandant, who joins me in leading the regiment forward.

It is an exciting time for our Army. Even as we gain the benefits of working within MANSCEN, Ron Johnson and I promise to preserve the distinct identity of our branch and to develop our vital contributions to the combined arms team as planned. We will follow the strategy laid out so well in *Engineer Vision 2010:*

Trained and ready

A responsive and versatile member of the strategic force

Exploiting information technologies to master terrain

We will continue to focus on the primary engineer functions of maneuver engineering, force support engineering, and terrain visualization.

As our force and capabilities evolve to meet 2010 goals, we need your help to keep us on track. As stated in the April issue of *Engineer* ("One Regiment, One Fight," page 9), we will follow LTG Ballard's lead if we work together and articulate our corporate Engineer Regimental goals to win friends and influence decision makers. Thus, the concept of "one voice" is necessary—all of us in the field and in the training base must articulate the same concepts and priorities to those outside our Corps. For this purpose we have posted our Engineer Regimental Positions on the school's home page and ask that you consult it [http://www.wood.army.mil/eschool/] before opining to others.

This in no way should be thought of as stifling your creativity. In fact, we want creative ideas and innovative concepts to be discussed, matured, and incorporated. This should be done internally within the regiment. We have added to our home page a direct e-mail line for engineer field-grade commanders to send the Assistant Commandant their ideas, concepts, questions, and comments (JohnsoRo@wood.army.mil). If you send us your ideas, we'll work them with the schoolhouse staff and respond. Help us keep the Engineer School relevant to both the field and training-base realities, just as you help us keep the school's planned modernization on track. While it is important to speak with one voice, it is equally important to dialog within the regiment to keep that one voice fresh, relevant, and energetic.

The schoolhouse is smaller now. Some of its former functions are now done by MANSCEN organizations, but this reorganization should not impact upon you. You can expect to receive responsive and useful products from your Engineer School. The dedicated professionals in your school work with the MANSCEN staff and will provide the answers and services you need.

I am pleased to see the range of articles submitted to *Engineer.* Continue to submit articles of current interest and encourage your subordinates to do the same. As you will read in this magazine, the Engineer Regiment is involved in the challenges that face our Army today: Kosovo, readiness, disaster relief, nation building, and homeland defense. Our young engineer experts are teaching us and leading us to professional competence. This is a time in our history where individual breadth is important. Whether you consider yourself a sapper or a light or heavy engineer, you must continue to learn all you can about maps, topography, doctrine, organizations, training, surveying, leadership, and history.

Contribute to others when you can. Share your experiences and expertise within the regiment by writing articles for *Engineer* and other branch journals. We keep our branch contributions relevant to our Army when we express our value to the combined arms and joint fight.

We showed off the *Grizzly* and *Wolverine*, respectively our number one and two acquisition priorities, during the national AUSA convention in mid-October. I was pleased to see many members of our regiment visit the production model of the Wolverine and the prototype of the Grizzly. It was gratifying to see members of the regiment bring their bosses and compatriots as well. That is just what we need to do as engineers. You could see in their facial expressions that, as people climbed on physically, they also climbed on mentally to the idea of in-stride breaches. Well done! Your next chance to show off is when the Wolverine is fielded at Fort Hood next summer.

Our past is one of honored achievements by individuals and units. Our present is a time of change, energy, excitement, and expectation. The future is ours to develop and shape. Essayons!

Engineer

November 1999 Headquarters, Department of the Army Volume 29 PB 5-99-4

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***Front Cover:** In the August timeframe, SSG Brown of 535th CSE fills a crater in a road made by the bombing of a Serbian military compound by NATO forces. The road led to a range used by the KFOR to qualify on their individual weapons.*

***Back Cover:** Historical example of the Army value "Personal Courage."*

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ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER Magazine, 320 Engineer Loop, Suite 210, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. ENGINEER's e-mail address is: bridgess@wood.army.mil. Our Internet home page is located at: http://www.wood.army.mil/ENGRMAG/emag_hp.htm.

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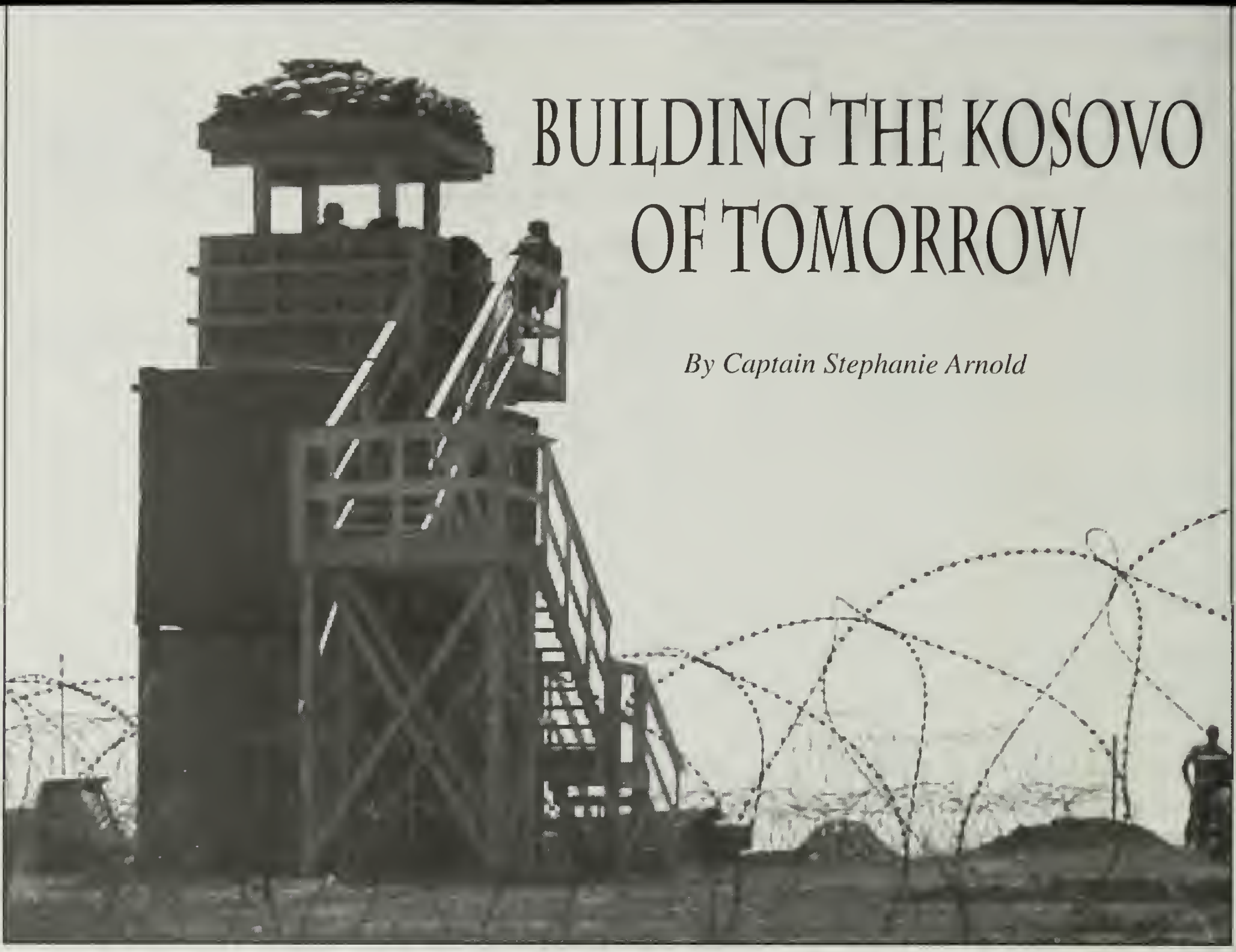


BUILDING THE KOSOVO OF TOMORROW

By Captain Stephanie Arnold

The 94th Engineer Combat Battalion (Heavy) (ECB[H]) is deployed to Kosovo in support of Task Force Falcon to help create Camp Bondsteel, the primary base camp in the American sector of Kosovo. Normally headquartered in Vilseck, Germany, the 94th ECB(H) is comprised of two line companies, a combat support equipment (CSE) company, and a headquarters and support company. For this deployment, the battalion has been augmented by the following units:

- 568th Engineer Company (CSE), Fort Riley, Kansas
- Alpha Company of 864th ECB(H), Fort Lewis, Washington
- 562nd/521st Firefighting Detachments, Fort Leonard Wood, Missouri
- 317th Maintenance Support Team, Vilseck and Bamberg, Germany

Although authorized only 708 soldiers in four companies, the battalion accounts for almost 900 deployed soldiers in six companies and two detachments. While operating within an 8-kilometer perimeter, the battalion boasts 17 construction platoons, six organizational maintenance platoons, and four direct-support platoons. These motivated and technically competent soldiers are a diverse blend of carpenters, electricians, plumbers, equipment operators, mechanics, cooks, and administrative personnel who are prepared to complete any mission.

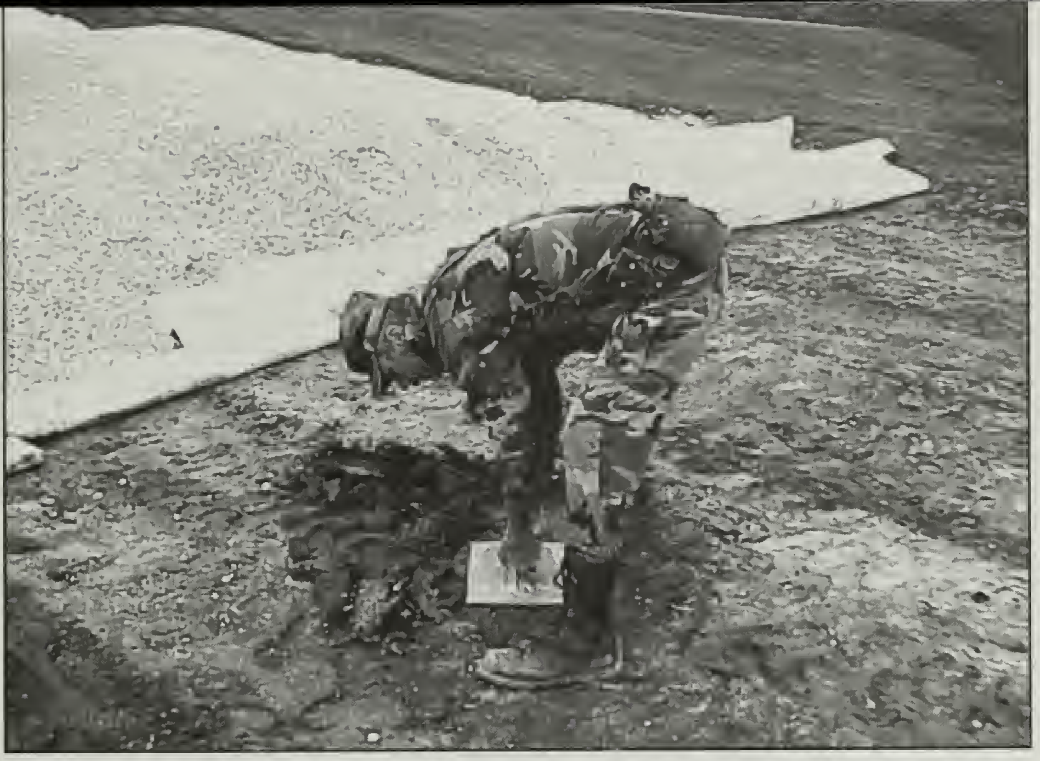
For Task Force Falcon, the battalion is attached to the 1st Infantry Division Engineer Brigade. The 130th Engineer Brigade (the battalion's organic brigade) also deployed its construction management section to provide managerial oversight, material acquisition assistance, and daily guidance to military construction engineers.

The Deployment

As U.S. Army Europe's only construction asset, the 94th ECB(H) has trained and prepared for both a peacekeeping and peace-enforcing deployment to Kosovo since late 1998. The 535th Engineer Company (CSE) deployed to Albania in support of Task Force Hawk in April 1999 to serve as V Corps' only military engineering asset for force protection and quality-of-life engineering support. In June, the 94th ECB(H) deployed an 80-person advance party to Albania. It was prepared to establish split operations in northern Albania while the battalion constructed the primary east-west main supply route into Kosovo. Five days after the advance party arrived in Albania, the political agreement was settled and the battalion was rerouted to Kosovo. Within two weeks, battalion surveyors and primary logistical leaders arrived at Camp

Bondsteel to prepare for the rest of the battalion and other converging Kosovo Forces (KFOR) units.

Unlike in Albania, where land use was determined on a first-come, first-served basis, the 94th ECB(H) surveyors were able to plan how the land should be used. Working with the 130th Engineer Brigade's construction management section, the 94th ECB(H) surveyors completed a topographic survey of the 750-acre area in 10 days. Using this data, the two construction cells determined interim locations for arriving units and the best layout for the base camp. The Construction Contracting Agency, comprised of both military and civilian engineers from the U.S. Army Corps of Engineers, designed the base camp while the battalion focused on internal project designs and quality assurance.



Soldiers prepare a dirt road for paving. The geotextile is covered with gravel and will be paved with asphalt.

Protecting and Housing the Force

The 94th ECB(H)'s mission in Kosovo is three-fold: provide force-protection support, provide quality-of-life support, and build operational facilities for Task Force Falcon.

Force Protection

Effective force protection is critical for Camp Bondsteel, which is situated on a series of rolling hills with nearby woods on several boundaries. After the 9th Engineer Battalion (Mechanized) used its armored combat earthmovers to create a hasty perimeter, the 94th ECB(H) and Brown & Root Services Corporation jointly completed a 2.5-meter-high earthen berm around the entire perimeter. They removed trees to allow sufficient fields of fire and built nine wooden guard towers around the perimeter. Due to soil, pests, and line-of-sight requirements, the battalion modified the towers by placing each on a concrete pad and adding safer and more accessible entrance ladders. Five of the nine towers were placed on two MILVANS welded together to allow greater visibility. The added elevation enables soldiers to view the area from 18 feet aboveground rather than from the usual eight feet.

Quality of Life

As when Bravo Company, 94th ECB(H) deployed to Bosnia-Herzegovina in 1998, the battalion's main construction effort has been life-support areas for the base camp. Because of the topography and population of the camp, it will eventually have two independently serviced life-support areas, with semipermanent wooden buildings known as Davidson-style Southeast Asian huts (SEA huts) (see article on page 8). The battalion is also creating SOCCE huts (modified for the Special Operations Command and Control Element) and officer/senior noncommissioned officer SEA huts that will have 10 rooms with separate latrine facilities for each pair of rooms.

Operational Facilities

The 94th ECB(H) created Camp Bondsteel's road system, which was critical to alleviate blinding dust storms and enable mobility when torrential rains made the clay soil impassable. They built the hardstand for the camp's hospital, created the road to the military and civilian materials yard, and laid a double-base surface of bitumen on the camp's eastern access road. The battalion upgraded the main briefing room and other areas throughout Task Force Falcon's command center. It also created a storage system for confiscated weapons and built floors for 200 tents, so soldiers would be out of the mud while SEA huts were being constructed.

Moving Mountains

To create life-support areas, the 94th ECB(H) transformed the topography of Camp Bondsteel to maximize use of the ground. The primary earthmoving mission, dubbed *Operation Wolverine Mountain* after the battalion's mascot, required that more than 150,000 cubic meters of earth be moved and redistributed. That is equivalent to the area of one football field that is 100 feet deep. To save time, the battalion lowered the two major hills in Camp Bondsteel and simultaneously filled the large ravine between them. Combining the efforts of all four organic companies, the battalion worked two shifts totaling 20 hours per day. At times twelve 621B scrapers, eight D7G dozers, three 130G graders, and six vibratory and sheepsfoot compactors operated on the hills. In 30 days, the battalion widened the life-support areas, created areas for the camp's wash rack and more than half of the camp's motor pools, and built a foundation for the northern access road.

Simultaneously, the battalion created the hardstand for the American logistical supply support activity. This 600- by 160-meter area, which required 70,000 cubic meters of earthen cut-and-fill operations, will eventually include a chapel, a morale and welfare tent, the Army and Air Force Exchange Service, and a barbershop. Equipment and operators from nine Wolverine platoons worked around the clock to complete the project.

Another earthmoving effort on Camp Bondsteel was the sewage lagoon. This project is environmentally critical since there were no sewage-treatment plants in Kosovo, and local people (including those serving military units) emptied raw sewage into streams. The lagoon is a technically challenging mission that requires all four of the 200- by 300-meter areas to have depth deviations from final design grade of no more than 3 inches. Led by the 535th and 568th Engineer Companies (CSE), the first area completed has a maximum deviation of only two inches across its entire 60,000-square-meter area.

Maintaining Engineer Excellence

The engineer effort in Kosovo is unlike any since the Gulf War. Even in 1995-1996 for Operation Joint Endeavor—when 1st Armored Division led the initial 20,000+ force into Bosnia-Herzegovina—the entire 94th ECB(H) deployed, augmented by the 362nd CSE from Fort Bragg. More importantly, the battalion was dispersed throughout the three brigade areas in the American sector. In Kosovo, all 900 Army combat heavy engineers are collocated at Camp Bondsteel.

This deployment provides our soldiers an opportunity to serve as America's engineer ambassadors. Military personnel from Great Britain, Greece, Poland, and Russia live on Camp Bondsteel, and the camp frequently has visitors from as far away as Nepal and Jordan. Representatives from these countries are impressed by the quantity and quality of the battalion's work.

The 94th ECB(H) also leads a variety of missions outside the camp's perimeter, which allows soldiers to provide vital assistance to the area. Each of the six companies sponsors an elementary or secondary school that was destroyed in the war or has been allowed to deteriorate. Completing basic repairs to the schools and building fundamental necessities, such as desks and chairs, provides a better learning environment for Kosovar children.

The battalion conducted reconnaissances of routes and bypasses throughout the American sector of Kosovo. It also repaired a former Yugoslavian

Water well No. 1, which is being constructed at Camp Bondsteel, will produce between 125,000 and 200,000 gallons of water per day.

military weapons range, which enabled KFOR units to maintain weapons qualification. The battalion repaired roads damaged during the NATO air campaign against the Serbian military and removed debris and dozens of destroyed cars from school yards and neighborhoods. Although not the unit's major effort, the soldiers enjoy honing their skills while helping to improve these people's lives.

Lessons Learned

When a unit completes a major exercise or deployment, several critical themes usually develop regarding lessons learned. Although the 94th ECB(H)'s deployment to Kosovo is not finished, lessons the battalion has learned may help other units prepare for similar missions.

1. Focus on continuous teamwork. This theme has many facets for the 94th ECB(H)—from intrabattalion efforts, to units added to the battalion, to different headquarters, to efforts with civilian contractors. Because the battalion is geographically dispersed among three German cities (Vilseck, Grafenwoehr, and Hohenfels), the companies' interactions in Germany usually are limited. Most missions there are completed by just one unit; in fact, the unit has not had a battalion formation in more than a year. During this deployment, almost every project has been completed by at least two companies, and several involved as many as four companies under the leadership of one platoon. Assimilation has been seamless because leaders at all levels stress teamwork.

Of the units that augmented the 94th ECB(H), only the 317th deployed with the battalion from Germany. Firefighters joined the battalion when the 535th CSE relocated from Albania to Kosovo, and the other companies arrived in early August. By establishing communication and working relationships before their arrivals, units quickly and smoothly joined the battalion's efforts to complete base camp construction. The battalion prepared living tents and working areas for units before their arrival, and incoming units received official welcome briefs that explained unit and camp policies. Leaders and soldiers in augmenting units are included in updates, professional development classes, morale-building events, and visitor briefs the same as those in organic companies. Except for different unit patches, the battalion merely enlarged into an enormous, cohesive unit.

The 94th ECB(H) motto is "Aid to any Division" for an important reason. In 1995-1996, the battalion supported the 1st Armored Division during Operation Joint Endeavor in Bosnia-Herzegovina. In 1998, it supported the 1st Armored Division and 1st Cavalry Division during Operation Joint Forge in Bosnia-Herzegovina. In 1999, when the United Nations mission in Macedonia transferred to NATO, the 94th ECB(H) supported the 1st Infantry Division. For this deployment to Kosovo, the battalion is again supporting the 1st Infantry Division.

The 94th ECB(H) has been fortunate to work under competent, professional divisional engineer brigade commanders and staffs with either extensive experience or a sincere appreciation for the capabilities and best employment of a combat heavy unit. A key factor to the battalion's successful construction management and resourcing was the inclusion of the construction management section from the 130th Engineer Brigade. Because it was familiar with the battalion and had experience with brigade-level management, the section provided needed guidance and liaison support between the construction engineers and the normally mechanized-focused divisional engineer brigade. This kept the teamwork focused at all levels within the units.

The battalion has worked with Brown & Root Services Corporation throughout this deployment. The military's flexibility and stability coupled with the contractor's experience and virtually unlimited work force will enable Camp Bondsteel to be completed before winter. For instance, the battalion had surveyors at the camp within two weeks after the peace agreement was signed, and equipment and operators followed 10 days later. The battalion was tasked to complete major cut-and-fill operations with its twenty-four 621B scrapers, whereas Brown & Root's experienced operators focused on the finishing work. The battalion's plumbers and electricians, who get little experience in Germany, worked with their professionally licensed Brown & Root counterparts to gain valuable experience. The soldiers also introduced Brown & Root workers to several military techniques. Brown & Root handles many camp functions, such as laundry, and will eventually provide all food services. However, the 94th ECB(H) performs various missions for the military to avoid costly and often time-consuming contracts. An amiable relationship helps the military and civilian workforce to reach our end state of providing force protection and improving quality of life for deployed soldiers.

2. Deploy with a robust advance party.

The deployment to Kosovo was a unique experience for the entire task force, because a significant number of personnel and supplies for this deployment were already in Albania for Task Force Hawk. Despite the difficulties of relocating from Albania to Kosovo, the effort was minimal compared to deploying from Germany.

The importance of the engineer force deploying early cannot be stressed enough. The advance party of battalion surveyors, construction planners, and section leaders provided Task Force Falcon with immediate and long-term planning capabilities. Unfortunately, the 94th ECB(H)'s entry was delayed because of the task force's intricate management of arriving units. Many major units had skeleton crews on the ground with areas already

A soldier ground guides a 621B scraper, which is loading fill material in a barrow pit.

established. As the battalion and construction maintenance section developed an initial camp layout, the task force moved several units. Others remained in place, and some still slow construction efforts, because they must relocate from nonresidential areas in the final base camp footprint.

Once in country, the 94th quickly began to create the perimeter berm, build primary camp roads, and construct tent floors with equipment and carpentry tool kits already in Albania. Since it may take 30-45 days for Brown & Root to get basic necessities into an area, engineer assets must have priority of movement to ensure that soldiers remain safe and healthy and have at least a basic standard of living. To capitalize on the military's quick responsiveness, initial entry assets must take engineer equipment, tools, and (when possible) materials such as lumber and nails.

3. Conduct deliberate planning and management.

Leaders and soldiers of combat heavy units often are pressured to conduct minimal planning and execute their plan immediately. Engineer leaders must balance project initiation speed with the need for deliberate planning. They must learn the commanding officer's engineering intent and priorities, develop a logical and detailed plan of execution, and have the commander bless the plan. Direction and support from the start of the mission will prevent duplicated efforts and attempts by lower-ranking commanders to divert the unit's efforts.

Designing and planning construction missions for nine earthmoving platoons, six vertical platoons, an equipment platoon, and an asphalt and concrete platoon is quite a feat for one battalion staff. The battalion capitalized on the experience of several junior officers, each of whom had deployed at least once to the Balkans, and senior noncommissioned officers in its construction cell to prepare for future missions while providing guidance on current missions. The battalion received exceptional help from both the 130th Engineer Brigade construction management section and the Corps of Engineers Construction Contracting Agency in planning and designing many missions. By working together, projects meet required technical specifications and execution time lines. The battalion combined all 21 surveyors, including those from the attached companies, to conduct topographical surveys, stake the designs, and provide quality assurance. One surveying team remained on the site of each earthmoving project to ensure quality control.

Engineer leaders must allow time to conduct quality maintenance when the unit is in a continuous construction operation. Garrison-like "motor stables" or maintenance stand-down days are unacceptable when construction deadlines are imminent. One successful method used on the battalion's 24-hour earthmoving sites was to perform daily shift maintenance. Maintenance crews stayed on site to perform emergency repairs. Projects stopped for an hour after each shift so the crew could lubricate and refuel equipment and perform preventive maintenance checks and services. Even with dust, heat, and continuous operations, the equipment maintained exceptional operational readiness rates throughout the mission.

4. Bring additional equipment based on the mission.

Fortunately the 94th ECB(H) knew its general scope of work before departing Germany. If a unit has not been to a particular area, it should gather as much information as possible before deploying. This intelligence will pay enormous dividends throughout the mission.

Based on previous deployments with similar missions, the battalion ordered two small Bobcat® skid steer loaders. These small, versatile pieces of equipment have attachments ranging from street sweepers to forklifts to buckets of various sizes and uses. Although the battalion has larger equipment for each of these functions, the Bobcat® has been extremely helpful when operating near SEA huts and in other built-up areas.

With six companies operating over a 750-acre area, continuous communication among the battalion and company leaders was critical. The commanders, battalion command team, and battalion S3 used hand-held Motorola radios with military nonsecure frequencies. Each company had internal communication among platoon leaders and company operations, and when the battalion assumed perimeter guard duties, soldiers in each tower used hand-held radios. This ability to immediately contact either subordinates or superiors for guidance, material deliveries, or command information ensured that the battalion continued to progress.

After leasing pneumatic air compressor nail guns in Bosnia-Herzegovina in 1998, the battalion ordered 14 nail guns and a million nails for the deployment to Kosovo. This equipment speeds production and helps maintain unit morale.

The 94th ECB(H) deals directly with Caterpillar® for repair and replacement parts for many pieces of engineer equipment. Through the director of military and governmental sales, the battalion requested that a Caterpillar® representative live and work with them in Kosovo. Within six weeks of arriving in country, a representative arrived with a satellite cellular telephone and Caterpillar® proprietary software that enables the battalion to order parts despite an unreliable telephone system. Parts are shipped directly through the dealer in Belgium to speed their arrival and reduce equipment down time.

Making a Lasting Difference

Although not complete, the 94th ECB(H)'s deployment to Kosovo has already been a great learning experience for leaders and soldiers. Soldiers will depart with greatly enhanced skills that only missions of this type can provide. Leaders at all levels will leave better prepared to handle future contingencies and a myriad of construction and leadership challenges. This deployment demonstrates how engineers of all types and backgrounds can work together to achieve a common goal. The battalion will depart Kosovo knowing it made a difference in this area for years to come.

Captain Arnold is the public affairs officer for the 94th ECB(H). She previously served as a platoon leader, executive officer, and adjutant for the 94th ECB(H). CPT Arnold has deployed to Bosnia, Albania, and Kosovo. She is a graduate of the United States Military Academy and the Engineer Officer Basic Course.

Operation Wolverine Mountain

By Second Lieutenant Margaret Warner and Sergeant First Class Timothy McGhee

Dust, heat, and mountains of tall grass were all that greeted the 94th Engineer Combat Battalion (Heavy) when it arrived at Camp Bondsteel, Kosovo, on 3 July 1999. Within 24 hours, the earthmoving platoon of Alpha Company, 94th ECB(H), received the mission to clear and level the two central hilltops that dominated the base camp. The initial horizontal earthwork foundation was the highest priority Army engineer project in the theater, because the first phase of SEA hut construction was scheduled to be completed by 1 October 1999 (see article, page 8). The success of the massive earthmoving project, which was completed ahead of schedule, can be attributed to the strong leadership of junior noncommissioned officers, an intense focus on maintenance, and the spirit of teamwork across the entire battalion.

Junior Noncommissioned Officer Leadership. Junior noncommissioned officers served as site supervisors, with each sergeant assuming responsibility for a cut or fill site on the project. Gaining experience and confidence as the project progressed, these squad leaders and assistant squad leaders ensured maximum efficiency and productivity of the soldiers and equipment in their charge. Two staff sergeants, who were the construction foremen for their designated shifts, coordinated equipment use, haul routes, and adherence to design specifications. Their responsibilities also included accountability of sensitive items, daily job-site safety briefings, work schedules, and daily construction goals. By relying on their junior leaders, the platoon leader and platoon sergeant were able to concentrate their efforts on providing construction guidance, resourcing, ensuring quality control of the project, briefing visitors, and planning projects.

Maintenance Focus. The massive earthmoving project required an intense focus on maintenance to keep the heavy engineer equipment running 18 hours a day for 16 consecutive days. To ensure consistent preventive maintenance, the construction effort included an innovative "maintenance hit-line." Twice a day during designated times, operators and mechanics worked together at this four-station assembly line to perform preventive maintenance checks and services, lubricate the lube points, clean air filters, and refuel the equipment. This approach to maintenance integrated the mechanics fully into the operation and ensured quality attention to the equipment. In addition, a team of mechanics remained on site during construction. With constant accessibility to mechanics, operators maximized the time their equipment was in use, which contributed immeasurably to productivity.

Battalion Teamwork. An essential element to the success of the operation was the sense of teamwork and joint effort across the entire battalion. The magnitude of the project required assistance from every company. Over the course of the project, soldiers from all companies felt a sense of ownership, and the operation benefited enormously from their initiative and selfless devotion of time and energy.

The efficiency necessary to complete an earthmoving project of this scale was possible because of the support provided by the company and battalion. For example, a squad of vertical construction soldiers from Alpha Company was designated solely as a support unit to assist the construction operators in every way possible. This squad transported meals to the job site, maintained and operated light sets, guarded sensitive items during construction, and marked obstacles on the project site. This allowed construction operators to continue working, which maximized productivity. The squad's motivation and initiative, such as creating the "Hilltop Inn" as a break area and makeshift chow hall, raised the morale of the equipment operators. The success of the construction mission also depended on the battalion's assistance in terms of survey support, dining facility support, and quality control inspections.

The greatest rewards reaped from this project lie in the construction supervisory skills of the junior noncommissioned officers involved in the project and the tremendous opportunity for construction equipment operators to improve their skills. Soldiers involved in the project feel a sense of pride in their contributions. The enhanced spirit of teamwork and cooperation has heightened the battalion's sense of identity as engineers for the rest of this deployment. Operation Wolverine Mountain truly validates the battalion's motto "Aid to any Division."

Second Lieutenant Warner is the project officer and Earthmoving Platoon Leader, A Company, 94th ECB(H). Sergeant First Class McGhee is the project NCOIC and Earthmoving Platoon Sergeant, A Company, 94th ECB(H).

KOSOVO BASE CAMPS:

IN THE AUGUST MELTDOWN, THE ARMY READIED FOR SNOW

By Dana Finney

Military engineers in Kosovo braved the summer heat to ensure that U.S. peacekeeping forces will be able to meet the demands of winter. While most military personnel at Camps Bondsteel and Monteith tried to keep cool, an intensive effort orchestrated by Headquarters, U.S. Army Europe (USAREUR), aimed to keep them warm this winter while sustaining the mission.

Task Force Falcon engineers are simultaneously managing hundreds of individual projects at the two base camps. Strategic planning enables the engineer team to expedite progress while avoiding duplication and unnecessary moves. This approach means that longer-term goals can be incorporated into day-to-day priorities. So while the original focus was on building the base camp infrastructure, plans include measures to support cold-weather operations in the coming months.

Engineer forces in Kosovo have a major commitment to build two base camps that will be home to 7,000 U.S. peacekeepers. More than 1,700 military engineers are working side by side with engineers from the Army Corps of Engineers and the private sector.

Coming in From the Cold

The engineers' rallying theme was "Soldiers in SEA huts by 1 October." A SEA hut, or Southeast Asia hut, is USAREUR's standard wooden temporary housing unit for climates like that of the Balkans. Using lessons learned in Bosnia, soldiers in Kosovo moved directly into Tier 2 tents located on a site where SEA huts would not be placed. This has avoided delays caused by relocating tents and people to accommodate SEA-hut assembly.

At Camp Bondsteel, which is being built from the ground up on former wheat fields near Urosevec, 160 SEA huts are arranged in 40 quads (clusters of four huts). Camp Monteith is embedded in a former Serbian military post near Gnijlane. Existing facilities at the site are used to house some personnel, and 64 SEA huts provide the rest of the housing.

Each 32- by 92-foot SEA hut includes a latrine and five rooms that sleep six to eight people. The rooms have fiberglass insulation in the walls, ceilings, and floors and are equipped with electric wall-mounted heating/cooling systems. Each SEA hut also has a 120-gallon rapid-recovery water heater.

The Army's commitment to move personnel from tents to SEA huts occupied most of the engineering resources and efforts at both base camps. Along with force protection and safety, improving soldiers' living conditions was the top priority, according to the chief of the Base Camp Coordinating Agency in Kosovo. Everything else was secondary.

The first soldiers began moving into completed SEA huts in mid-August. Some Tier 2 tents probably will be left up to handle surges of personnel during unit transitions, but all personnel assigned to the Kosovo camps for any duration will live in enclosed housing.

Soldiers from Company A, 94th ECB(H) cut lumber for SEA hut trusses at Camp Bondste

USAREUR met its self-imposed October 1 deadline to move soldiers into SEA huts before the onset of cold weather, which typically occurs in mid- to late October.

Readying to Dig Out

With SEA-hut construction almost completed, Task Force Falcon engineers are looking ahead to other challenges winter will bring. Among those are heavy rains and snowfalls. A single winter storm historically may dump as much as 22 inches of snow in the area. In coordination with Kosovo Forces (KFOR) headquarters, Task Force Falcon engineers are assessing requirements for snow removal as well as the most cost-effective means to do it.

"KFOR will probably have a central storm-response cell at the headquarters in Pristina," said the operations officer of 1st Infantry Division Engineer Brigade at Camp Bondsteel. "Engineers there are looking at what's available in country and trying to develop local contracts to help with snow removal. But there's not a lot of capability here, as we've discovered when seeking local construction support."

With hundreds of earthmoving vehicles already in Kosovo, the most affordable option would be to retrofit what's there rather than import new equipment. A 5-ton dump truck can be outfitted with a blade and sand spreader, and plows can be attached to smaller vehicles like HMMWVs to clear secondary roads.

In typical engineer fashion—making do with what is available—a snow and ice clearance/abatement (SNIC) package was cooperatively developed by the 1st Infantry Division Engineer Brigade; the Office of the Deputy Chief of Staff for Engineers, USAREUR/7A; the Assistant Corps Engineer, V Corps; and the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL). The package includes 5-ton-truck snowblades, HMMWV snowblades, and both towed and mounted sand/salt spreaders. USAREUR initiated procurement of equipment through USACRREL on 18 August. The items, along with technical experts to help with equipment installation, arrived in Skopje, Macedonia, in late October.

KFOR's central snow-removal effort will likely focus on main supply routes. NATO forces within the country will be responsible for keeping roads passable in their assigned region, as dictated by operational and humanitarian missions. Inside Camps Bondsteel and Monteith, Brown & Root Services Corporation will clear snow as part of a sustainment services contract.

Soldiers from 94th ECB(H) construct walls for SEA huts.

Local Kosavars help place concrete foundation pads for SEA huts.

Another consideration is whether the Army will be able to buy sand and salt locally. The area doesn't have natural sand pits but may be able to get "manufactured" sand, which is material screened from rock quarrying activities. It's expensive, but may be less costly than bringing sand in from another country.

While most of the Army's snow and ice cleanup will be mission-driven, engineers will coordinate closely with civil affairs units assigned to outlying villages. When engineer assets are available, they can help with emergency civil functions, such as clearing access roads and ensuring that schools and hospitals have power and water.

Modeling the Winter Terrain

Nearly every military activity in Kosovo depends on the Army's terrain and mapping capabilities, and winterizing is no exception. The power and flexibility of geographic information systems (GIS) allow planners to model multiple variables and create maps reflecting their relationships. For example, a 100-year storm can be superimposed with maps showing damaged roads to predict if a particular route would be passable. During winter preparations, engineers use GIS for mapping main supply routes, alternate routes, and local roads to allocate plows and other equipment. In addition to these operations, GIS supports winter tactics at the base camps.

"We've been modeling terrain and weather factors that could potentially contribute to a 'state of siege' when people are isolated from food, water and power," said the intelligence officer of 1st Infantry Division Engineer Brigade at Camp Bondsteel. "Elevation is the primary concern. We're also looking at terrain features—how landforms on slopes, called *spurs* and *draws,* will affect people's ability to move about after a storm." A spur is a higher elevation run, while draws are lower, valley-like areas where snow tends to drift.

This assessment uses historic weather data from the Pristina Weather Observation Center along with satellite data from the National Imagery and Mapping Agency and other sources, including NATO reconnaissance. Terrain and weather data are combined with maps showing "hot spots" of violent activity. The information indicates from a tactical standpoint where snow-removal equipment is needed to help quick-reaction forces respond to emergency situations.

Shaping the Landscape

Combat heavy engineers from the 94th Engineer Battalion ECB(H) are reshaping nearly all of Camp Bondsteel's 750 hilly acres to achieve the level subgrade needed to site temporary facilities. The battalion is building ditches and other drainage structures to handle heavy rains and snow melt during the winter. Much of the grading for the camp has resulted in gradual slopes that will be easier for all vehicles to maneuver in the snow.

The Balkans' freeze-thaw cycle was an important consideration in the earthwork. According to the construction foremen of A Company, 94th Engineer Battalion, only areas that are pure "cut" have SEA huts on them. The fresh-cut earth has a 3 percent grade, which allows good drainage and navigation and prevents the SEA huts from sinking. Motor pools and storage facilities will be built on filled and compacted areas.

Using Lessons Learned

History cites countless military campaigns that suffered or failed because of severe winters—from Revolutionary War soldiers in freezing weather at Valley Forge, to Napoleon's ill-fated push through the Steppes, and the Nazi's resounding defeat in Russia. In the United States, with its well-planned interstates and modern snow-removal equipment, most winter storms only slow people down. But in Kosovo, a harsh winter without preparation could threaten the peacekeeping mission.

Thanks to engineers, the lessons from history—and more recently from the U.S. experience in Bosnia—are helping prepare for the worst in Kosovo, in what many predict will be a "winter of discontent."

Ms. Finney is an Army Corps of Engineers public affairs officer on temporary assignment to the 1st Infantry Division Engineer Brigade in Kosovo. Her home base is the U.S. Army Construction Engineering Research Laboratory, Champaign, Illinois.

Sets, Kits, and Outfits:

Pioneer, Minefield Marking, and Demolition Tool Sets

By Alan Schlie

This is the second of four articles on sets, kits and outfits. This article focuses on pioneer tool sets and minefield marking and demolition tools. The first article discussed tool sets for the construction trades; the third will be on bridging, diving, lighting, and fire-fighting tools; and the fourth will feature tools for technical trades and topography.

Pioneer tool sets have remained relatively unchanged since the Korean Conflict. The only modifications in the past decade have been to eliminate tools not used during combat training center rotations. Yet the commercial tool industry has made some innovative changes to the old "pick and shovel" for ergonomic and manufacturing reasons, as well as to increase productvity, and we have updated the Army's tool sets to incorporate these innovations.

Materials

Plastics have captured a large share of the manufacturing market, especially as a material for tools, cases, and handles. Flexibility of use and ease of manufacturing are only two of the reasons. The capability to mold plastics in various colors and imprint messages in the material are other reasons for their popularity. For example, good wooden handles are expensive to manufacture and are becoming hard to find; therefore, many users don't replace handles, they just buy new tools. In the new pioneer sets, most of the tools with handles use a plastic-fiberglass composite patented by the NUPLA® Company. Tools that don't have cushioned grips to reduce the transmission of shock to the arms have ribbed vinyl grips to reduce hand slippage.

Set Descriptions

The **Squad Pioneer Tool Set (Light)** is available in two versions. If the squad vehicle is a truck or a Bradley, the set weighs 400 pounds and is packed in two high-impact plastic, olive-green Hartigg® storage and transport cases measuring 68 inches long by 15 inches wide by 15 inches high (they resemble coffins). When the squad vehicle is an M113 armored personnel carrier, the tools are packed in two aluminum boxes specially designed to replace the seats. The tool set weighs 500 pounds.

Components of the two sets are identical and include a selection specifically prepared for the combat engineer who "drops" in on the target. Components include the MAX®, a multipurpose tool that can be configured as a shovel, axe, rock pick, clay spade, rake, or hoe, which takes up less space and weighs less than the individual tools. Normal D-handle shovels and pick-mattocks are provided for more serious excavations. The shovels have a serrated point, which easily cuts through sod and small roots but also works well in rocky soil. A picket pounder and a smaller picket cap speed wire emplacement and save sledge-hammer handles. As added protection, the sledgehammers and axes have thick rubber cuffs at the juncture of the handle and head. The machete is replaced by the Woodsman Pal®—a 17-inch swinging tool with a machete edge and a brush hook. It comes with its own sheath and sharpening stone. Mine/countermine tools include mine probes, mine-marking bonnets, minefield-marking tape, engineer tape, parachute cord, trip-wire grapnels, and steel tie wire.

New items are two *Tactical Rappelling Kits* and the *Nail-Driver Kit*. Each Tactical Rappelling Kit contains 75 feet of 3/8-inch-diameter Kermantle® rope, a figure eight, rappelling harness, an anchor strap, carbiners, Prusik cord, snap links, and a carrying bag. Although these kits increase the squad's

Squad Pioneer Tool Set (Light)

Platoon Pioneer Tool Set

deployment options, they also increase training and inspection/certification requirements.

The .27 caliber *Nail-Driver Kit* contains heavy and medium loads sufficient to drive various pins, studs, and nails into steel and concrete. A variety of straps, couplings, and clips can be used to hang demolitions on bridge piers, stringers, or bunker walls; or to run demolition firing lines. The nail driver—which comes with its own cleaning brush, oil, and carrying case—can also be used for framing or sheathing buildings; constructing bunkers; installing electrical wire; or posting signs, pictures, or notices. Units may need to revise their security and safety procedures to properly store this kit.

The **Squad Pioneer Set (Land Clearing and Building Erection)** will be used in squads of corps wheeled, composite, airborne, and light battalions; squads of combat heavy battalions; squads of port opening and pipeline companies; and in utility sections. This set contains hand tools not found in other sets that are used to clear land and erect buildings. In addition to the tools contained in the Squad Pioneer Set (Light), this set has additional shovels, a single-bit axe, a double-bit axe, pinch and pry bars, rakes, a felling lever, a vise, a seven-piece grip pliers kit and wrenches, marking flags, special hooks, a 1-ton ratcheting chain hoist, ratcheting tie-down straps, rooftop anchors, and full-body support harness kits (for working on roofs or other off-the-ground projects).

A number of optional tools are available, based on mission need and the commander's authorization. Some of these are in the 4-ton, hand-operated hydraulic ram set for moving, spreading, lifting, and positioning large structural members. Inflatable bag jacks, air inflators and gauges, bottle jacks, and electrical extension cords may be required for some construction and recovery tasks.

Although each engineer squad is authorized a chain saw by separate line identification number (LIN), supporting items are in the squad pioneer tool sets: a file set to sharpen the chain; a pair of camouflage-patterned safety chaps to protect legs from cuts; a clear polycarbonate, antifogging face shield to replace the goggles; a five-gallon safety can for the gas-oil mix; and timber wedges to assist in felling trees.

The **Platoon Pioneer Tool Set**, which is used by most combat engineers, is being reassigned to units authorized the Squad Pioneer Tool Set (Land Clearing and Building Erection). This set provides squads with tools needed infrequently or that are too costly to equip each squad.

The centerpiece of the Platoon Pioneer Tool Set is a Model 763 Bobcat® skid steer with combination bucket, auger, paving breaker, and forklift attachments. The 46-horsepower diesel engine provides the skid steer a 1,500-pound operating capacity, a hydraulic flow rate of 15 gallons per minute at 3,000 pounds per square inch, and a road speed of 7 miles per hour. The bucket's capacity is up to 12.9 cubic feet and has a lift pin height of 114 inches. The auger unit comes with variable extension and augers of 12-, 24-, and 36-inch diameters. It can auger to depths of 8 feet, and two side-by-side 24-inch holes can easily be connected for a fighting position. The forklift, which has 42-inch-long tines that adjust to widths up to 48 inches, reaches high enough to offload pallets and pickets from the cargo bed of a HEMTT. The hydraulic breaker can be positioned for vertical or horizontal strokes of the moil point, asphalt cutter, tamper, or picket driver. A concept evaluation in June 1997 determined that using the skid steer and picket driver reduced squad emplacement times for triple-standard concertina wire by 40 percent. Other attachments can be obtained for specific missions at the commander's discretion.

Additional sledgehammers, rakes, shovels, pry bars, engineer tape, and tie-down straps are included to support squads in specific tasks. New tools include clay picks, tarps, a bungee cord kit, RoboGrip® pliers, hand-held star bits and chisels with grips/guards to protect hands from misplaced hammer blows, drum deheader, vise, stapling hammer, pole- and tree-climbing kit, log jacks, and peavey. To support tasks that require chain saws, there is an electric chain-saw

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sharpener, abrasive blades, depth gauge, calipers, and goggles.

A portable, gasoline-powered, 1.75-ton winch with 3/16-inch cable is provided for logging, skidding, recovering, ferrying, erecting, assembling, and disassembling tasks. Additional pulleys, wire rope, clips, thimbles, swivel hooks and anchor shackles allow a variety of applications for the winch. A hydraulic cable cutter, pocket socket kit, log chain, and cable-pulling clamps complete the list of tools to support working with wire rope.

The **Platoon Pioneer Tool Set (General Labor)** also has been revamped. It now provides noncombat/construction engineer platoons with pioneer tools needed to develop a defensive perimeter. It is suitable for a bridge platoon, equipment platoon, headquarters and headquarters company, or any other nonengineer platoon or company. The set contains shovels and picks for 28 soldiers, plus axes, sledgehammers, posthole diggers, bow saws, rakes, machete/brush hooks, picket pounders, and hatchets. Hand files, goggles, chain-saw chaps, bolt cutters, marline, engineer tape, adjustable wrenches, hacksaws, combination saws, hammers, pliers, tape measures, and twine are also included. In some cases, this set eliminates the requirement for the platoon or company to maintain a complete squad carpenter set. The Platoon Pioneer Tool Set is transported in four Hardigg® cases and weighs 400 pounds.

Either the old or the new NSN can be used for the Platoon Pioneer Tool Sets to meet the requirement of the LIN, which gives unit commanders the option of retaining the old sets or purchasing new sets as needs arise and funds become available. Units that retain old sets still meet all readiness reporting criteria. However, some items in the old sets will be replaced by like items in the new set, such as tools with NUPLA® handles, and will not need to be procured with the new set.

The **M133 Hand-Emplaced Minefield Marking Set (HEMMS),** NSN 9905-01-019-0140, is unique in the sense that it is not subject to the 5-year review cycle. The employment, operation, and maintenance of the HEMMS are contained in Technical Manual (TM) 5-9905-200-01. Changes to the set may be requested on a DA Form 2028, *Recommended Changes to Publications and Blank Forms*, sent directly to the Commander, U.S. Army Communications - Electronics Command, Fort Monmouth, New Jersey. The HEMMS is a means of guiding friendly forces safely through or around our scatterable or conventional minefields. It consists of a line of poles containing flashing lights connected by fluorescent orange tape to temporarily mark minefields. However, if the minefields are to be left in place longer than 15 days, the HEMMS should be replaced with Minefield Marking Set #2.

Components are considered to be part of the end item; as such, they must be with the end item whenever it is issued or transferred between property accounts. A complete set will mark 700 to 1,000 meters of fence. The set can be reused until there are too few parts to mark 400 meters of fence; at that time, partial sets should be combined. *Remember to install new batteries in the lights before using the set.* The HEMMS is available through the common table of allowance at one per active Army category 1 company, two per active Army combat engineer company, and one per unit as required for training. The set weighs 175 pounds and is transported in a plywood box.

Unit Responsibilities

The Platoon Pioneer Tool Set introduces a number of training, transporting, and maintenance issues that units must resolve. The skid steer operator has not been identified, and there is no training course available in the Army school system. Units must designate operators and provide training for them and the mechanics. This will include a combination of on-the-job training, the Bobcat® operator course that comes with the set, and the local dealership's assistance. There are 92 dealerships around the world that are ready to provide help, but the key to operator proficiency is stick time.

The set includes boxes for storing and transporting hand tools, but there is no trailer to transport the skid steer and attachments. For the time being, the skid steer, which weighs 5,368 pounds, and the attachments, which weigh 2,200 pounds, must share a ride on other unit transporters.

Because commanders had expressed an immediate need for the skid steer based on its recognized utility, a decision was made to proceed with two courses of action. First, the skid steer would be included in the Platoon Pioneer Tool Set, and a national stock number (NSN) would be obtained. This action allows commanders to purchase and retain the set if they have a requirement and funding. Secondly, systems development and operational requirement documentation would proceed along the normal course, eventually providing for a separate LIN, development of maintenance data, inclusion of a dedicated transporter, and normal procurement and fielding.

The **Demolition Equipment Set (Electric and Nonelectric Initiating)** is currently being revised. The introduction of modernized demolitions initiators, which are basically nonelectric initiators, will not eliminate electrical circuit components yet, because they are still available in the supply system. New items that may be added are explosively formed penetrator kits, linear-cavity charge kits, linear-shaped charge kits, or conical-cavity charge kits adapted from the M303 Demolition Set. Of particular interest are the means of attaching charges to various surfaces—zip ties, bungee cords, telescoping poles and stands, and adhesives/tapes. Sound-suppressed nail drivers may be needed in combat units to

Revised Tool Sets

NSN	Description	LIN Number	GSA Price
5180-01-447-2200	Carpenter's Squad Box Tool Kit	W34648	$1,724.25
5180-01-447-2199	Carpenter's Platoon Box Tool Kit	W34511	2,848.95
5180-01-441-2123	Base Maintenance Woodworking Tool Kit	T16988	9,164.33
5180-01-461-8105	Electrician's Squad Tool Kit	W36977	7,541.10
5180-01-461-8110	Mason Squad Tool Kit	W44923	6,153.69
5180-01-467-4679	Pioneer Squad Light Tool Kit	W59240	5,281.25
5180-01-467-4691	Pioneer Squad Light Tool Kit/M113 Units	W59240	7,562.50
5180-01-467-4685	Pioneer Squad Land Clearing and Building Erection Tool Kit	W48348	7,875.00
5180-01-467-4677	Pioneer Platoon Manual Labor Tool Kit	W48074	51,875.00
5180-01-467-4684	Pioneer Platoon General Labor Tool Kit	W48211	6,750.00
5180-01-461-8170	Plumber's Platoon Tool Kit	W48759	7,817.86
5180-01-461-8108	Plumber's Squad Tool Kit	W48622	5806.45
5180-01-467-4676	Plumber's Tool Kit	W49033	3,225.00
5180-01-441-2125	Multisaw and Drill Tool Kit	NA	3,758.61
5180-01-441-2124	Pneumatic Nailer and Compressor Tool Kit	NA	2,868.64
5180-01-441-2122	Table Saw and Router Tool Kit	NA	2,537.08
5180-01-436-8537	Cordless 18-Volt Power Tool Kit	NA	2,117.66

create anchorage points. How to transport the demolition specialist's tools of the trade is also under consideration. While the demolition materials are a Class V item and not considered part of the set, there are a multitude of new techniques—including binary mixes, explosive cutting tapes and sheets, and explosive water-metal liner combinations—and delivery concepts.

Since the first of this series of articles on sets, kits, and outfits was published (*Engineer*, August 1999, page 54), NSNs have been obtained for all of the tool sets. Units may obtain the complete set at the present time; however, the old sets must be retained until all set components have been given NSNs and a supply catalog is published. As of the September 1999 *Consolidated Publication of Component Lists* (EM0074, CD-ROM), only the LINs for the Squad and Platoon Carpenter's Sets list supply catalogs for both the old and new NSNs.

Since the first article, there also have been changes to the Plumbing and Pipefitter Sets. Each individual plumber will be authorized a *Plumber's Tool Kit (Field Maintenance)*, LIN W49033, NSN 5180-01-467-4676, for maintenance and repair as well as installation of new plumbing pipes and fixtures. The *Pipefitter's Tool Kit (1/8-inch to 2-inch-Diameter Pipe)* and *Plumber's Supplemental Tool Kit (2 1/4-inch to 4-inch Diameter Pipe)* will be placed at platoon (or team) level based on the mission need to install, replace, or repair pipe.

The modified table of organization and equipment authorizations for various sets may change as requirements are realigned.

Summary

As always, input from the user is necessary to continue to create tool sets that help soldiers accomplish their missions. Send your ideas and comments to the Director of Combat Developments, Engineer Division, Organization Branch (Tom Knotts or Alan Schlie), 320 Engineer Loop, Suite 141, Fort Leonard Wood, Missouri 65473-8929. Telephone numbers are commercial (573) 563-6191, DSN 676-6191, and fax (573) 563-4089/5056. The e-mail address is *schliea@wood.army.mil.*

Mr. Schlie is a force development analyst with the Directorate of Combat Developments, U.S. Army Engineer School. A retired command sergeant major, he has served in various capacities in Europe, Korea, and CONUS throughout his career.

OPERATION FUERTE APOYO: DISASTER RELIEF IN NICARAGUA

By Major Jeff Eckstein

When Hurricane Mitch hit Central America in late October 1998, the country of Nicaragua suffered extreme damage. On 22 November, the 36th Engineer Group, Fort Benning, Georgia, deployed its lead elements into the country as part of the U.S. relief effort known as Operation Fuerte Apoyo (Strong Support). The 36th was the command and control headquarters for all U.S. forces deployed to Nicaragua to support disaster relief and humanitarian assistance operations after the hurricane. The group headquarters formed the nucleus of Task Force Build Hope (Nicaragua [NU]) with the group commander becoming the task force commander. The group staff received augmentation for communications, medical planning, public affairs, and humanitarian operations.

Nearly 1,700 U.S. forces deployed to Nicaragua, including aviation, medical, logistic, civil affairs, and engineer units. The 36th was charged with developing a plan to facilitate long-term recovery efforts in Nicaragua. This plan included repairing farm-to-market roads, constructing a clinic at Wiwili, preventing an epidemic outbreak, providing bilateral primary health care in devastated communities, and delivering relief supplies. Task Force Build Hope (NU) completed 125 kilometers of road; installed 24 culvert systems; constructed a 5,600-square-foot, wood-framed clinic; evaluated 4,240 Nicaraguan patients; conducted 47 surgeries; vaccinated 3,634 dogs for rabies; and delivered 681 tons of relief supplies.

Keys to Mission Success

Operation Fuerte Apoyo proved to be a challenging and successful deployment for the 36th, and *having a known mission duration helped. From day 1, the Nicaraguan government, the U.S. Embassy, and Task Force Build Hope (NU) personnel knew that all work must be completed by 15 February 1999.* This made staff planning accurate and allowed the S3 to forecast requirements. A fixed date that did not move also helped prevent mission creep.

Defining the Mission

The key to defining the mission in Nicaragua was excellent communication among the various national-level ministries, the U.S. Embassy, and the task force commander. Embassy personnel possessed background knowledge of Nicaragua and the various existing programs. The Nicaraguan government had its priorities and expectations, some of which were not disaster relief or humanitarian assistance. The task force commander had a substantial capability and, through detailed reconnaissance, had the best firsthand knowledge of the situation in the countryside. Nicaraguan priorities that were outside the task force's capability or mission were discussed up front, and all parties agreed that the United States would not do the work. By synthesizing this information, the 36th Engineer Group staff developed a scheme of operations for engineer, medical, and relief operations that provided a defined, achievable end

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state. The U.S. Embassy and the Nicaraguan government approved the end state before work began. This approach ensured that the task force was bought into the end state, limited false expectations from the host nation, eliminated mission creep, and ensured that U.S. work facilitated long-term recovery efforts.

Host Nation Expectations

The Nicaraguan people and many members of the Nicaraguan government viewed U.S. relief efforts as a fix-all for the country's infrastructure problems. Although other countries responded immediately after the hurricane hit, they completed limited amounts of work. When U.S. forces arrived almost two months later, many Nicaraguans expected them to repair more roads and build new bridges, leaving the country with a vastly improved road system. The United States brought in a large number of soldiers and two shiploads of equipment, which appeared to offer an incredible capability. In reality, there were only 30 workdays available, no permanent bridging capability, and only one combat heavy battalion with a combat support equipment company.

From the first meeting, we outlined our mission—which was to repair roads—and explained our capabilities and limitations. However, we were receptive to the Nicaraguan needs. *One important aspect of dealing with such high expectations was to select an attainable goal for the engineer effort and stick to it. Coordinating with the embassy so the embassy staff could work with other agencies to assist the Nicaraguan government also was important.* The task force performed reconnaissance for various out-of-scope projects and furnished the results to the government. The task force was always clear about our mission, never hinted at doing additional work, and allowed the embassy staff to deal with providing U.S. assistance through other channels.

Road Selection

When the international community responded with aid and relief supplies, some nations rebuilt roads and bridges that were damaged or destroyed. The Nicaraguan government repaired and reopened the Pan American highway throughout Nicaragua within 30 days after the hurricane. The remaining infrastructure that required work was in the countryside—usually dirt roads that were rutted, washed out, or covered by mud slides. The Ministry of Transportation and Infrastructure identified more than 1,200 kilometers of such roads that needed work.

The task force commander and task force engineer conducted extensive aerial reconnaissance of all damaged areas. The task force commander decided that the priority of horizontal effort would be farm-to-market roads that branched off the Pan American highway. Using this guidance, the task force engineer section conducted ground reconnaissance of 350 kilometers of road. Based on the time available, production estimates, and the holiday season, Task Force Build Hope (NU) agreed to rehabilitate 85 kilometers of road and install 20 culvert systems.

Several issues developed during planning. Much of the equipment in the combat heavy battalion was too large to work on many of the roads. In addition, the roads were in poor condition before the hurricane, and guidance from Joint Task Force Aguila was to restore roads to prehurricane conditions. This meant that dirt roads remained dirt roads. This plan was not what the Nicaraguans expected.

Since it was impossible to mass equipment on any given road, the task force selected many shorter roads. To ensure that U.S. efforts had a positive impact on the local populace, we planned our repairs to begin and end at a population center or main crossroad. *The key to route selection was to cover a wide area and clearly define the end state.*

U.S. Embassy

Even though the task force was given a mission by Joint Task Force Aguila, the U.S. ambassador made all commitments between the United States and the Nicaraguan government. This arrangement prevented many problems. By working closely with the embassy staff and allowing them to coordinate with Nicaraguan ministries, there was never a disconnect on what the task force saw as the best course of action and what the ambassador wanted to accomplish. The embassy staff provided a wealth of information on the country and had established ties with the local media and police.

A representative from the Task Force Build Hope (NU) command group attended weekly meetings of the country team and reconstruction team at the embassy. Various working groups included Nicaraguan officials, embassy personnel, task force staff, and nongovernmental organizations. These working groups coordinated actions and completed staff work to ensure mission accomplishment. Some of the working groups were for security, humanitarian relief, and *New Horizons* (the U.S. Southern Command's exercise for nation assistance in Central America).

Base Camps

In conjunction with selecting roads for rehabilitation, the 36th Engineer Group staff conducted reconnaissance for base camps. The Nicaraguan military offered the task force several of their military bases. Considerations for base camp locations included a water source, hardstands, permanent buildings, helicopter landing zones, security, and proximity to work sites. After selecting locations, the task force worked with the Nicaraguan armed forces to secure land and facilities and establish security forces. *By working closely with the Nicaraguans, the task force located 1,500 personnel in the interior of the country without disturbing the local populace.*

The U.S. units purified all water in the base camps and contracted for telephone and Internet service in areas serviced by the Nicaraguan telephone company. Some areas even had cable television service. Most of the units burned their trash on-site and used either burnout latrines constructed by the engineer battalion or locally rented port-a-johns. Food was prepared in a mobile kitchen trailer. Each base camp had a different standard of living, but each made quality-of-life improvements throughout the deployment.

Contracting

On the first day in Nicaragua, the commander and staff realized that two things were required before anything could be accomplished: a contracting team and funds. Initially, rental vehicles, hotel rooms, and food were out-of-pocket expenses for soldiers on deployment orders. When a contracting team—a captain and an NCO—arrived from Fort Bragg, they began purchasing or contracting for basic life support. This included water, food (initially there were limited MREs in country), lodging, transportation, cellular telephones, and fuel. During the past 25 years, embassy personnel were the only U.S. military presence in Nicaragua, so there was no infrastructure to support U.S. forces.

Soldiers from the 63rd Engineer Company (CSE) compact the bedding material for a culvert.

The logistics and construction efforts in Nicaragua were overwhelming for the two-man contracting team. Negotiating with contractors, coordinating requirements, and finding sources of supplies takes time. While 90 percent of the task force's requirements were available in Nicaragua, no single source could supply the necessary quantities.

Funding is always an initial hurdle in short-notice deployments. Most subordinate units deployed with field ordering officers and funds from their home station, but the limited sources of supply prevented use of the funds.

A recommendation for improving the responsiveness of contracting teams to deployed units is to assign a contracting officer to engineer groups and brigades in the same manner that the JAG is assigned to a unit. The contracting officer would work for the installation while in garrison but would deploy with the unit. *The most important aspect of contracting is to begin early.*

Construction Groups

Selecting a construction group rather than a combat group proved to be valuable. The only difference in the two groups is that a construction group has a 15-person design and management section that can design, manage, and provide quality assurance for theater-of-operation construction. This capability allowed the 36th Engineer Group S3 to be the task force S3 and focus on operational issues throughout the task force. The design engineer became the task force engineer and focused on the engineer mission. The design section designed a 5,600-square-foot, wood-framed clinic with indoor plumbing, a septic system, electricity, and a metal roof. The management section and quality assurance soldiers conducted ground reconnaissance and surveyed numerous project sites throughout the country, which helped in developing a project list for the embassy for *New Horizons 99*. The engineer section also helped the contracting team identify and procure construction materials.

Augmentation

The 36th Engineer Group staff was the core of the Task Force Build Hope (NU) staff. A humanitarian operations officer, a medical planner, a public affairs officer, a logistics assistance officer, and a large communications package augmented the group staff.

The civil affairs team in Nicaragua led the Humanitarian Operations Cell and coordinated all humanitarian relief efforts for the task force commander. A medical planner from the medical task force served on the staff and kept the commander informed on medical issues, such as coordination at the national level, medical evacuations, and daily medical humanitarian assistance missions. Public affairs and logistics assistance officers provided normal staff coordination and assistance to units.

The communications package enabled the task force to communicate with Joint Task Force Aguila in El Salvador and allowed limited communications with subordinate units in Nicaragua. The communications team provided DSN and Internet access and digital nonsecure voice terminal (DNVT) support. The civilian telephone system in Nicaragua did not cover the 120- by 160-mile area of task force operations. The engineer group's large communications package allowed the task force to maintain DNVT communication to three of its seven sites in Nicaragua. Without this package, the task force could not have maintained communication with the entire force throughout the country, because FM networks could not cover such distances.

A staff officer in the S3 section was designated the S3 Air, although this was not a modified table of organization and equipment (MTOE) position. He coordinated flight missions for the aviation task force, subordinate units, VIP tours, staff elements, and the commander.

Another element that was not part of the staff but was located in the same operations center was the Air Force Tactical Air Liaison Control Element (TALCE). The TALCE monitored fixed-wing aircraft flights into and out of Nicaragua and provided a cargo-handling capability. The task force was without a TALCE for about three weeks, which was a disadvantage. For example, sometimes aircraft showed up without notice and needed material handling equipment that was not available. This led to contracting for a forklift to stand by. The TALCE was an invaluable asset to the task force. *Future deployments of this nature, where the need for air transport of supplies and passengers is high, should have immediate access to the TALCE or a similar element.*

Force Protection

Force protection was a crucial element of Operation Fuerte Apoyo. The task force S2 coordinated with Nicaraguan intelligence officers to assign 800 Nicaraguan soldiers to provide security for work sites, base camps, and convoys. In the forward operating bases (FOBs), Nicaraguans furnished perimeter and external security while U.S. forces provided internal security and maintained a ready reaction force. Units developed battle drills to handle convoy ambushes, sniper fire, drive-by shootings, bombings, and explosions. The U.S. forces only operated during daylight hours and used a two-vehicle rule for all movements. Convoys from the port to each FOB had Nicaraguan army security and police escorts.

Health promotion and preventive medicine were important components of force protection. Soldiers kept their BDU sleeves rolled down, ate only from approved sources, ensured that potable water was always available, and sprayed for insects and rodents. These measures helped prevent serious incidents and injuries during the deployment.

Construction Materials

Since construction materials were limited in country, a bill of materials (BOM) could not be bought off the shelf. For the clinic construction, the engineer section sent someone "shopping" with the contracting team so substitutions could be made. We also had problems getting accessories and hardware for items such as doors, toilets, water heaters, and lights; much of the time, the components had to be bought separately. It took merchants from one to two weeks to deliver large quantities of supplies, with any amount over 10 being considered a large quantity. Managua, the capital, was the only location in the country where all required materials were available.

Due to long lead times in ordering materials and the remote stationing of engineer units, the engineer battalion could not purchase its own BOM after it arrived in country. Therefore, the engineer section coordinated for purchasing the constructing unit's BOM before it arrived in country. This caused problems with transferring the BOM to the unit and discrepancies in what the unit wanted on hand.

Reinforced concrete pipe was used extensively for culvert systems. Each 1-meter-long section of pipe was from 1 to 2 meters in diameter and required a crane to lift it into place. Corrugated PVC pipe was available also. It was lighter and easier to install, but because such large diameters were needed, the pipe sometimes crushed or collapsed when it was installed. Efforts to retain the shape of the PVC pipe required much more work than installing concrete pipe. Personnel who were knowledgeable of construction materials were needed to help the contracting team and manage materials for the Wiwili clinic. *It was important that the task force began the procurement process before units arrived in country.* This ensured that Task Force Build Hope (NU) could complete all its work by mid-February.

Nicaraguan Media

Dealing with the media anywhere is a challenge. In Nicaragua, it was no different. Since seeing U.S. forces in the country was new to many Nicaraguans, the local press was very interested in activities of Task Force Build Hope (NU). The task force worked closely with the embassy's public affairs officer to ensure that accurate information was provided to the press. The embassy coordinated several trips so Nicaraguan media could visit construction sites, medical treatment centers, and base camps and observe humanitarian relief efforts.

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GERMAN CONSTRUCTION MAINTENANCE FACILITY

Lieutenant Colonel Richard B. Hook

Concurrent with the huge drawdown of the U.S. Army in Europe in 1994, TRADOC reduced the number of liaison officers in Germany from a peak of 16 officers in 1992 to the current level of seven. The officers are "military ambassadors" to the 16 German army schools scattered across the reunified country. They serve as military points of contact between the American and German armies and assist wherever possible in the exchange of unclassified information. This exchange generally follows the DTLOMS model (doctrine, training, leadership, organization, materiel, and soldiers). The officer also writes a bimonthly report that outlines current major activities within the Engineer, Chemical, Military Police, and Signal Branches of the German army.

Training Facilities

Some of the most fascinating aspects of the liaison officer's position are seeing the day-to-day operations of the German army; observing its training methods; meeting its officers, sergeants, and soldiers; and learning about its "trend-setting" military training facilities. One such facility is the Construction Maintenance Facility (CMF) near Ingolstadt (1.5 hours north of Munich). Since 1997, the German Army Engineer School has operated this unique training facility to prepare engineer officers, sergeants, and soldiers for United Nations and NATO deployments to Albania, Bosnia, Croatia, and Macedonia.

This article outlines the "who, what, where, when, and why" of the German Army Engineer Construction Maintenance Facility as an example of a facility that CONUS-based or U.S. Army Europe engineers could use or recreate at another location. This type of facility would help U.S. Army Corps of Engineer soldiers review mobility, survivability, and general engineering tasks used during deployments. Not all units have the time or facilities to train on these tasks at their home station.

The CMF belongs to Training Department B of the German Army Engineer School. The detachment commander, an engineer captain, supervises 15 military and civilian personnel who are experts in various technical specialties. They serve as key advisors and trainers for the classes and unit training conducted at the CMF. The commander has an operating budget of 180,000 DM ($100,000) per year, with which the CMF provides an amazing amount of training capabilities and facilities to the German army engineers.

Training Capabilities

The CMF once served as a training installation for German army engineer bridging units that conducted fast-water bridge training on the Donau River during two-week training cycles. In 1996, the German Army Engineer School began changing the facility to a pre-deployment training site for engineers deploying to support

Aerial view of the Construction Maintenance Facility near Ingolstadt, Germany.

Two German engineer NCOs assess building damage in Bosnia; structural assessments are taught at the CMF.

the Multinational Division Southwest in Bosnia-Herzegovina. Initially, two buildings were converted to a training and test facility where engineers learned to find and disarm booby traps; make basic structural repairs to buildings; repair electrical, water, and sewer lines; and learn basic force-protection skills. Since 1997, the CMF has captured numerous lessons learned from deployed German army engineer units in Bosnia and has added training on carpentry, roofing, masonry, surveying, railway repair, well-drilling, base camp construction, and standard and nonstandard bridging.

Organization

The training facility is organized into 28 training stations. Nine stations are used as basic engineer training sites, where basic carpentry, electrical, water, sewer, masonry, surveying, and engineer equipment skills are taught. Many of these sites are indoors, and the soldiers are supervised by licensed master carpenters, electricians, and masons. The primary goals at these stations are:

- Teach or improve engineer soldiers' skills in basic engineer tasks.
- Recycle and reuse materials used by previous classes or units.
- Improve existing training facilities at the CMF while training engineer soldiers.

For example, several carpentry classes built training aid models while learning basic carpentry skills.

Thirteen stations are used as advanced engineer training sites. Instructors teach or units practice work-site reconnaissance, project planning, identification and removal of booby traps in buildings, repair of interior and exterior water and sewer lines, reinforcement of damaged wooden or masonry buildings, internal and external force-protection measures for buildings, and restoration of external and internal power supplies.

Six stations encompass standard and nonstandard bridging, base camp construction, road repair, railway repair, and advanced building repair training. The bridge training site offers engineer units the opportunity to train on Bailey, medium girder, and Mabey-Johnson bridges and to construct timber trestle bridges and wooden piers. At the railway repair site, engineers train to use a hydraulic device to raise or remove railway cars from damaged railway beds. The advanced building repair training includes installation of toilets and showers, roofing repair, door and window installation, and masonry and concrete construction.

A key point emphasized at all 28 training stations is that soldiers, sergeants, and officers must realize that their units will deploy to areas with limited engineer resources. Creativity, initiative, and alternative solutions to engineer problems are emphasized. There is no standard answer to each engineer challenge. For example, as part of the electrical and plumbing training, soldiers are required to install light fixtures using car lights or similar nonstandard devices and to connect a showerhead using the earpiece of a telephone. These are lessons that soldiers learned in Bosnia.

Training Programs

Not every engineer unit or class that trains at the Construction Maintenance Facility has the time or supervisory personnel to train at all 28 stations. There are three types of training programs:

Predeployment

For units preparing to deploy outside of Germany, training is conducted during a three-week cycle with company-sized units. Commanders and platoon leaders coordinate with the training facility to develop a unit-specific deployment training plan. This gives each unit commander the flexibility to decide what areas his unit must train on given the short training period. Many units provide some of the senior sergeants required to supervise specific engineer training stations at the facility.

Exercises

The two-week training program allows engineer platoon and squad leaders to plan a three-day engineer exercise while soldiers receive basic engineer training at any of the 28

CMF bridge training site with a constructed bridge pier.

stations. Platoon leaders can develop an exercise that concentrates only on combat engineer, construction, or bridging skills or a combination of these skills. For example, platoon leaders may organize a three-day exercise where the platoon only installs basic electrical, water, and sewer systems. Or they may construct a timber trestle bridge and remove booby traps from buildings to be occupied during a simulated deployment.

Small Groups

In this program, units may train small groups of engineer soldiers or sergeants. For example, some engineer units send a group of 10-15 sergeants to learn or review specific carpentry, electrical, or masonry skills. Commanders may conduct training in Ingolstadt that is not available or is too expensive to provide at the unit's home station.

A Unique Opportunity

German army engineers have cleverly "recycled" a nearly abandoned engineer installation into a unique NATO engineer training facility. British, Dutch, and French individuals and units also have trained there. The U.S. Army Corps of Engineers could use this facility to prepare soldiers, sergeants, and officers for deployments into areas of operation with limited resources. Platoon leaders and company and battalion commanders would be amazed at the skills their units can learn in a compact time frame at this one-of-a-kind facility.

German army engineers are eager to train with U.S. Army Corps of Engineer units. Who will send the first U.S. Army engineer unit to this excellent combat engineer facility? I hope to see your unit soon!

For more information, e-mail Lieutenant Colonel Hook at *hookras@bas.army.mil.*

Lieutenant Colonel Hook is a TRADOC liaison officer in Munich, Germany. He previously served as the S3, 293rd Base Support Battalion, Mannheim, Germany. LTC Hook is on his fifth overseas tour and speaks German, Turkish, and Spanish.

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The task force commander attended a press conference held by the Nicaraguan government at the start and completion of every mission. Nicaraguan officials documented the U.S. tasks to be completed and also the final accomplishments. Press coverage of U.S. activities was favorable throughout the deployment. Nicaraguan government officials quickly rebuffed isolated incidents of negative coverage, and the embassy clarified incorrect information as necessary. *In dealing with the press, always speak with one voice, keep a simple message that explains the mission, and allow the media access to all work sites.*

Nicaraguan Military

The Nicaraguan military staff organization was similar to that of the United States. Seven Nicaraguan military liaison officers worked with Task Force Build Hope's (NU) primary staff officers. Each liaison officer had a thorough knowledge of our organization and capabilities.

In addition to providing security, the Nicaraguan military had a radio system that used repeaters, which made it possible to communicate throughout the country. They tracked all convoys, check points, and rest stops with the same accuracy that U.S. units reported.

The Nicaraguan military is poorly equipped and lacks many resources. Although it does not have a professional NCO corps, its officer corps is highly competent and professional, and many officers are combat veterans. The Nicaraguan armed forces executed its missions of ensuring U.S. security and providing assistance as requested to the highest standards.

Building a Foundation

The mission to Nicaragua for disaster relief and humanitarian assistance was a rewarding experience for the 36th Engineer Group and the entire task force. Personnel and units received valuable training in many of their mission essential tasks and gained experience in conducting an unscheduled deployment. The task force not only improved the lives of many Nicaraguans devastated by Hurricane Mitch, they also built a foundation for future military relations.

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The 14th Combat Engineer Battalion: A Model Multicomponent Unit

By First Lieutenant Tim Piccirilli

When the guidon passed in front of then Chief of Staff of the Army, General Dennis Reimer, on 10 April 1999, Bravo Company, 14th Combat Engineer Battalion (Corps) received a new commander. At the same time, the company completed the process of force integration by transitioning from the Active Component to the Washington Army National Guard. The ceremony served as the capstone to the nearly year-long process of leading the Army through force integration. As the Army prepares for the future, the 14th serves as a model multicomponent unit. It fully embraces the following four principals of Total Force integration detailed by Secretary of Defense William S. Cohen and later emphasized by General Reimer in his white paper "One Team, One Fight, One Future."

- Clearly understood responsibility for ownership of the Total Force by senior leaders throughout the Total Force.
- Clear and mutual understanding of the missions for each unit—Active, Guard, and Reserve—in service, joint, and combined operations, during peace and war.
- Leadership by senior commanders—Active, Guard, and Reserve—to ensure the readiness of the Total Force.
- Commitment to provide the resources needed to accomplish assigned missions.

This article details some of the processes, lessons learned, and mechanisms instituted by the 14th Combat Engineer Battalion during its transition to a force-integrated unit.

Defining Measures

In mid-FY98, the 14th Combat Engineer Battalion, the famed "Rugged" engineers, was notified that it would become a multicomponent battalion by transitioning one of its companies to the Washington Army National Guard. Having no example from which to work, the command group and staff agencies involved in the upcoming transition first sought to define the problem and its parameters.

Headquarters, Department of the Army, defines a multicomponent unit as "a unit which is authorized personnel from more than one component (Active, National Guard, and/or Reserve) on a single document." This means that multicomponent units mobilize as a single, integrated entity. Therefore, the National Guard company would serve with the rest of the battalion in wartime. Implementation of this status would come from a memorandum of agreement between the Active Component and the National Guard.

To achieve this goal, a team consisting of the commanders and staff at Fort Lewis, the Washington Army National Guard, and the 14th Combat Engineer Battalion agreed on the following set of parameters based on goals stated in FM 100-11, *Force Integration*:

- Enhance effectiveness in warfighting capability.
- Balance capabilities to maintain all core competencies.
- Create flexible processes to evolve the force in any direction, consistent with guidance and available resources.

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Armed with goals and parameters, this team faced the initial problem of the transition—selecting which company in the battalion to deactivate.

Selection Process

The battalion staff briefed the commander on its recommendations concerning which company to transition. The motivation in selection was to minimize turmoil for soldiers. The staff offered several alternatives to the commander based on financial, readiness, personnel strength, and retainability criteria. Keeping in mind the goal of minimizing the impact to active duty soldiers, the commander selected 14th Combat Engineer Battalion's Bravo Company to move forward with the process. With an outgoing commander and relatively low personnel strength, Bravo Company was in the best posture to transition.

Personnel

The command sergeant major, the battalion S1, and the company first sergeants planned how to manage soldier movement during the transition with a minimum of turmoil. Working together, they determined that the company could phase itself out through natural attrition. This meant transferring soldiers throughout the battalion so that soldiers who were in Bravo Company during the transition would no longer be "Rugged" at the completion of the process.

Using natural attrition rates and the transition time line, the battalion moved soldiers with 90 days or less retainability to Bravo Company to head the transition effort. These soldiers changed out with their more stable counterparts in the rest of the line companies throughout the battalion in order to bring them to or above 100 percent strength. Most of the remaining soldiers in Bravo Company, who had more than 90 days retainability, moved into positions throughout the battalion where modified tables of organization and equipment (MTOE) shortages existed. However, there were exceptions. Critical positions in the transition process, such as supply personnel and senior leaders, remained in the company to lead the effort and provide continuity.

Equipment

Early on, leaders decided that the success of the force integration process required complete integration of the Washington Army National Guard into the battalion. To facilitate this, the 14th decided that Bravo Company would remain in existing Active Component facilities, assume control of Active Component equipment, and receive force-modernization enhancements in conjunction with the company's active duty sister companies.

To ensure proper handling of equipment in the transition, the installation, I Corps, the 14th Combat Engineer Battalion, and the Washington Army National Guard established a constant communication link. This came about by creating a detailed time line and consistent in-process review schedule. Exercising both of these tools and ensuring participation by all involved parties made it possible to proactively identify and solve issues and concerns inherent to the transition process.

A concern during the transition was to ensure a relatively seamless flow of equipment to the National Guard company. To help achieve this goal, the battalion's parent unit, the 555th Engineer Group—in conjunction with Headquarters, Department of the Army, and the National Guard Bureau—took the approach that the National Guard owned the equipment before it assimilated the unit and adopted the multicomponent

B Company soldiers will train alongside their active duty counterparts. Events like this live mine training will allow the "Rugged" battalion to fully function as a multicomponent force.

MTOE. The first step was to identify the exact equipment composition of Bravo Company. Unquestionably, the company would mirror the MTOE of its active duty counterparts. Further, it would use the same equipment that the Active Component Bravo Company had used.

In addition to outfitting the National Guard company with the same equipment as active duty companies, the battalion fielded several new pieces of equipment and added these items to the National Guard company's MTOE. Rather than receiving the equipment at a later date, the National Guard became active participants in the fielding process. Involvement in the force modernization process included acquiring FMTVs (family of medium tactical vehicles) to replace the older 817-and 920-series 5-ton dump trucks, the all-terrain crane, and laser leveling devices for the graders. Adding these items to the company's inventory and ensuring that it had operators trained on the equipment guaranteed a continuity of integration between the new National Guard company and the battalion.

Maintenance

Another key to the transition process and cross-leveling of equipment was the creation of an agreement between the Washington Army National Guard and the Active Component on the inspection and inventory of equipment and vehicles. By conducting a joint technical inspection between Active Component Bravo Company mechanics and incoming National Guard supply and maintenance personnel, the two units ensured the transition of quality equipment.

Since the Washington Army National Guard used its equipment only during weekend drills and annual training—much less than its active duty counterparts—a plan was needed to determine maintenance requirements for these vehicles. Because the National Guard used the vehicles less did not mean that the vehicles would receive less attention; instead, it demanded that this equipment receive special attention and a regular maintenance schedule. To accomplish this, the battalion used its MTOE to its advantage. With all of the battalion's mechanics assigned to Headquarters and Headquarters Company, the battalion did not have to be concerned about a loss of daily maintenance support. Instead, it could keep the knowledgeable asset already on hand. The team of active duty mechanics assigned to Bravo Company possessed institutional knowledge of the equipment, its history, and nuances. With this team, the National Guard company would possess an active duty maintenance force that could assure constant maintenance and dedication to equipment readiness on a daily basis. This plan served both the National Guard and the battalion. With the National Guard company wartraced with the 14th, equipment readiness is necessary to ensure that vehicles are ready for missions and deployments.

It was essential to establish the link between Active and National Guard maintenance systems to accomplish equipment readiness. The battalion maintenance office worked with the 555th Engineer Group, the company maintenance team, and the Washington Army National Guard maintenance personnel to create a flexible system that allowed growth and learning by operating from the two systems. Issues such as prescribed load listing/transportation Army aviation maintenance (PLL/ TAAMS), unscheduled maintenance, reporting procedures, and hazardous materials were resolved with a memorandum of agreement between all parties. Direct support, higher-level maintenance, and parts requisitions are accomplished by the National Guard maintenance team at Camp Murray, Washington. Camp Murray is adjacent to Fort Lewis, which makes coordinating for this higher-echelon support a simple process. By establishing and recognizing the concerns and missions of each component, the area of maintenance in the multi-component battalion became a living document.

The Next Century

The 14th Combat Engineer Battalion, the most decorated engineer battalion in the active duty Army today, realizes that the mission of force integration is far from finished. The battalion continues to build on the solid foundation established during initial stages of the integration process. It focuses on the advantage that proximity offers by having the National Guard company use the same equipment and facilities as its active duty counterparts,

The future includes combined training events for all members of the battalion. National Guard officers will participate in the staff ride to Little Big Horn; National Guard soldiers will fire alongside their active duty peers on various weapon systems, execute demolition ranges, and participate in the battalion drivers training program. This peer/mentor relationship will be the support system of the multi-component battalion that the 14th is today. By integrating and welcoming its National Guard counterparts in every facet of the battalion's operations—from training to social events—the 14th Combat Engineer Battalion is ready to lead the Army into the 21st century.

First Lieutenant Piccirilli is the maintenance officer, 14th Combat Engineer Battalion, Fort Lewis, Washington. Previous assignments include platoon leader and executive officer, 14th Combat Engineer Battalion. 1LT Piccirilli is a graduate of the United States Military Academy and has completed the Engineer Officer Basic Course.

Book Review

Brave Decisions: Moral Courage From The Revolutionary War to Desert Storm, by Colonel Harry J. Maihafer, U.S. Army (Retired), Brassey's Incorporated, Washington, D.C., and London, 1995, 263 pages, ISBN 0-02-881108-9 (hard cover).

The strength of the United States has always depended on courageous, decisive leadership in its armed forces. The heroes who have emerged from more than 200 years of conflict are lauded in books, movies, and popular culture—names like Washington, Grant, Lee, MacArthur, and Patton. In this book, Colonel Maihafer reveals a different, less glamorous side of military leadership. Decisions made from great moral courage are his subject, and he develops a comprehensive picture of the substance of leadership through a study of 15 great American military leaders and their exceptional moral courage.

From the opening page, the author grabs our attention with a stirring account of Colonel Daniel Morgan, the "Ranger of the Revolution," as he leads a motley but motivated group of militiamen against Lieutenant Colonel Banastre Tarleton's 1,100 British Regulars at Cowpens, South Carolina. As the author points out, Colonel Morgan's stunning victory over Tarleton was not due to superior tactical genius, but to Morgan's personal courage and willingness to fight trained British Regulars with untrained militia. Colonel Morgan's actions in the face of superior forces showed the British that, after six years of fighting, the American Army had developed officers and soldiers capable of defeating them in a fixed battle. Ten months later, Lord Cornwallis surrendered to General George Washington.

Most of the vignettes used in this book to illustrate moral courage are stories of colonels and generals, successful men in positions of great influence. What the stories reveal, however, is that these men developed and refined their moral and physical courage while they were junior officers. We are introduced to a young Captain Douglas MacArthur as he conducts a dangerous reconnaissance mission in Mexico in 1914 at the request of the Army Chief of Staff, Leonard Wood. Captain MacArthur's determination to complete the mission despite deadly encounters with Mexican bandits and disloyal allies established him as a man of great personal courage. More than 30 years later, General Douglas MacArthur displayed great moral courage when he supervised the rebuilding of Japan despite great pressure to punish the Japanese for their actions in World War II.

Captain Robert E. Lee developed similar attributes during the Mexican War in 1846. Captain Lee distinguished himself many times in combat and won the respect of General Winfield Scott for his display of loyalty and duty. When Colonel Robert E. Lee resigned from the United States Army in 1861 to take a position in the Confederate States' army, he sadly tendered his resignation despite the urging of General Scott to remain with the Union. The unquestionable honor and integrity he had developed as a young captain in Mexico served Lee well as he made one of the most difficult decisions of his life.

The author does not examine only "battlefield courage," however. He affords us a glimpse into difficult decisions made by great military men in briefing rooms, embassies, and even a court martial, decisions that impacted millions of people and helped shape the way America deals with nations around the world. Colonel Maihafer takes us to the side of Major General John J. "Black Jack" Pershing, as he resists enormous pressure from the Europeans (in World War I) to commit the newly arrived American Expeditionary Force before it is ready. We stand with General Lucius Clay in Berlin as he organizes the famous Berlin Airlift, which allowed the people of Berlin to face down the threat of Soviet occupation and prevail despite significant public sentiment to abandon the city to the Russians. We see Colonel Billy Mitchell's courageous defense of America's need for a strong air warfare capability, in a court martial that resounded through the halls of Congress and that led eventually to establishment of the Air Force.

The United States Army has long recognized the need for leaders who have both physical and moral courage. The Army values of *Leadership, Duty, Respect, Selfless Service, Honor, Integrity,* and *Personal Courage* have been clearly visible in America's leaders—from men in buckskin during the Revolutionary War to soldiers in the hot sands of Kuwait and Iraq. Although popular culture often glamorizes war and focuses on heroic acts of physical courage performed on foreign battlefields, Colonel Maihafer reveals another side of American soldiers and leaders. The moral courage required to make difficult decisions is not the stuff of Hollywood, it is the stuff of heroes. In this book, Colonel Maihafer pays fitting tribute to 15 soldiers and leaders who deserve our gratitude and admiration.

Captain Joseph E. Wyka serves as Commander, D Company, 169th Engineer Battalion, Engineer Advanced Individual Training, Fort Leonard Wood, Missouri.

Homeland Defense at Fort Leonard Wood

By Jim Smith

On 29 September 1998, the basic color scheme for Fort Leonard Wood shifted even further from green to purple. On that date, Major General Robert B. Flowers, commander of the Maneuver Support Center (MANSCEN), activated the Center of Excellence for Homeland Defense (CoE-HLD). The CoE-HLD's mission is to provide horizontal integration of all aspects of homeland defense. This integration is "purple" because it brings together Army, Air Force, Coast Guard, and Marine Corps players in support of civilian authorities. Over time, more information will follow on this merger.

Why Fort Leonard Wood?

The CoE-HLD activation culminated a nine-month effort to execute orders of the Chief of Staff of the Army to center the military's homeland defense efforts at one military installation. Since the MANSCEN already trains all four services in skills applicable to homeland defense, Fort Leonard Wood was the obvious choice.

A major academic arm of the U.S. Army's Training and Doctrine Command (TRADOC), the MANSCEN is the centralized location for combat and training developers for the Engineer, Chemical, and Military Police Schools. It is also home to the Maneuver Support Battle Laboratory and OPTEC's Test and Evaluation Coordination Office. The MANSCEN possesses a modeling and simulations center capable of comprehensive operational analysis and war gaming. Fort Leonard Wood's staff, faculty, and installation personnel have repeatedly proved that they can take on emerging missions and execute them in a highly professional manner. Additionally, Fort Leonard Wood is a large installation with space for new training missions, ranges, and growth potential to meet 21st century challenges.

Fort Leonard Wood is also home to the 7th Military Support Detachment (MSD) Rapid Assessment and Initial Detection (RAID). The 7th MSD (RAID) is one of 10 such detachments, each assigned to one of the 10 Federal Emergency Management Agency regions. When not training or responding to homeland defense missions, the 7th MSD (RAID) serves as the model for experimenting on improvements to all RAID detachments.

The TRADOC mission to produce trained soldiers, airmen, sailors, and marines is part of everyday life for the MANSCEN workforce. MANSCEN directorates speak the common languages of doctrine, training, leader development, organization, materiel, and soldiers (DTLOMS). Whether writing a new field manual or lesson plan, developing a new hardware system, challenging leading-edge technologies, or teaching new soldiers to survive on a future battlefield, MANSCEN personnel excel. They work together to ensure the success of homeland defense.

What is Homeland Defense?

To some degree, homeland defense is what the military has done for more than 200 years: defend the citizens, possessions, and infrastructure of our nation and its territories against enemy attack. But the homeland defense mission extends beyond defense against overt military attack from a foreign source. The mission has four basic axes:

Weapons of Mass Destruction (WMD)

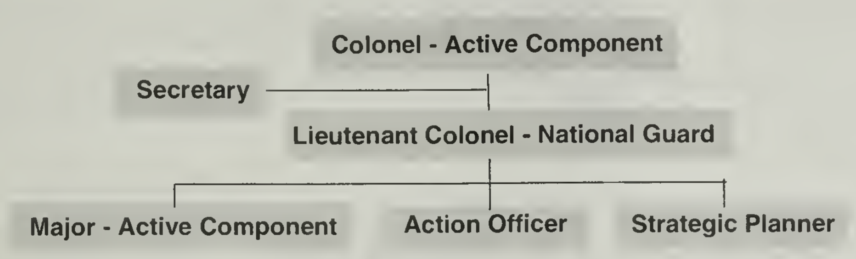
This is the most publicized mission today. WMD and homeland defense are used together so often that some people think they are synonymous. They are not. The United States makes a soft target because of its size, freedom to travel without restriction, and massively built-up areas with largely unprotected populations. WMD can be bought, built, or smuggled into the country with relative ease.

Most citizens understand that the WMD threat exists and most still harbor the fear of "The Bomb" as a holdover from the Cold War. Although the probability of a WMD attack is small, its relative payoff is huge for a minimal cost. Most Americans have strong feelings about the Oklahoma City bombing and never want to see such a disaster repeated.

Force Protection

Many official sources argue that force protection is a strictly military mission that occurs outside the continental United States (CONUS). But force protection is critical across the spectrum of operations: protecting the troops'

TPIO-HLD Organization



	Future Players	
U.S. Coast Guard	TRADOC Program Office - One Semiautomated Force	Army Medical Department
U.S. Marine Corps	U.S. Air Force	Soldier Biological, and Chemical Command

home station, during their transit to a port of debarkation, while in transit to a deployment area, and after arrival at the deployment site outside of CONUS. There remains an important mission to safeguard the force that supports our national military strategy concept of force projection.

Civil Disturbance

The U.S. military responds to civilian requests for support through the Military Assistance to Civil Authorities program. Although one of the least popular missions for military personnel, riot control is still a homeland defense mission to safeguard citizens against one another. Acting as an arm of the state governor, the National Guard continues its historical precedence of controlling riots or major civil disturbance—a mission that predates the nation.

Natural Disaster

An obvious mission for homeland defense is responding to violent acts of nature, such as tornadoes, hurricanes, floods, or earthquakes. The military brings to bear trained troops who can live and work under austere to hazardous conditions. Those same soldiers, airmen, sailors, and marines accomplish their missions even more successfully when protecting their own families, homes, and communities.

A major player in homeland defense is the Army Corps of Engineers. Although not a direct arm of homeland defense, the Corps is always there to save lives, hold back floodwater, keep precious roads and bridges open, and maintain open lines of communication.

Who is Responsible for Homeland Defense?

MANSCEN's homeland defense workforce currently is under the Maneuver Support Battle Lab, whose head is both the Battle Lab's deputy director and the TRADOC Program Officer until TRADOC activates the TRADOC Program Integration Office for Homeland Defense (TPIO-HLD). The colonel in charge of the TPIO-HLD will report directly to the MANSCEN commanding general. TPIO-HLD responsibilities encompass all DTLOMS issues affecting homeland defense. All combat and training developments and war-gaming issues will be coordinated through the office. Although TRADOC's TPIO-HLD model shows only a six-person staff, the planned workforce includes Coast Guard, Army Reserve, other TRADOC schools, and possibly other military branch liaison officers. Even though TPIO-HLD may eventually include a dozen action officers, the office will still task subject matter experts throughout the Department of Defense to accomplish its mission. The TPIO-HLD's function is to coordinate and integrate homeland defense functions—not work those functions in a vacuum.

What's in the Future?

The Maneuver Support Center will continue to train the world's best soldiers, airmen, sailors, and marines. The MANSCEN challenge is to ensure that all outside agencies know where to find homeland defense expertise and to keep all lines of communication open. We have already begun to export our expertise by teaching classes at the Command and General Staff College, at Active and Reserve Component conventions, and to the civilian community via safety councils and emergency planning offices. The future of homeland defense is growing and fascinating. "More to follow" is more than a catchphrase in CoE-HLD; it is our daily work ethic. But more to follow…

Mr. Smith is a combat developments materiel analyst at the U.S. Army Engineer School, Fort Leonard Wood, Missouri. He holds a master's degree from Central Missouri State University and has completed Command and General Staff College, Combined Arms and Services Staff School, Ordnance Officer Basic and Advanced Courses, NBC Staff Officer Course, Materiel Acquisition Management Course, Combat Developer's Course, MANPRINT Course, and the Hazardous Materiel Course.

Red Devils!

The 58th Combat Engineer Company

By Captain Leonard J. Law and First Lieutenant Keith R. Ferdon

The 58th Combat Engineer Company (CEC), the "Red Devils," provides mobility, survivability, and countermobility support to the 11th Armored Cavalry Regiment as it performs its primary mission as the opposing force (OPFOR) at the National Training Center (NTC). This article is our response to numerous questions about the OPFOR engineers and how they fight.

To understand the doctrine of the Krasnovian engineer, it must be put into the context of how the 11th Armored Cavalry Regiment fights on the NTC battlefield, which is based on former Soviet army and Warsaw Pact doctrine. However, in the words of the 11th Armored Cavalry Regiment Commander, Colonel John D. Rosenberger, *"We are a capabilities-based force. We must be a freethinking enemy in order to give rotational units the best possible training opportunity."* This means that we employ our doctrinal assets using whatever method is necessary to accomplish our mission—driven by the mission, enemy, terrain, troops, and time available. Additionally, we do not hesitate to take a page from the book of any force's doctrine, including that of the United States, to achieve success. The emphasis is on integrating the engineer effort into a combined-arms operation.

During NTC rotations, the 11th Armored Cavalry Regiment leadership steps up one level. The regimental commander assumes the role of the 60th Motorized Rifle Division commander, with the commanders of the 1st and 2nd Squadrons commanding the 125th Guards Tank Regiment (GTR) and the 32nd Guards Motorized Rifle Regiment (GMRR), respectively. Fighting units on the battlefield are the 125th GTR and 32nd GMRR on alternating rotations. A motorized rifle battalion (MRB) is formed by combining an armor troop from 1/11 Armored Cavalry Regiment and an infantry troop from 2/11 Armored Cavalry Regiment. During a 125th GTR rotation, armor commanders and platoon leaders are in charge, with their infantry counterparts acting as deputy commanders. During a 32nd GMRR rotation, this is reversed.

Engineers operate somewhat differently, with the 58th CEC commander stepping up to command an ad hoc organization designated the 46th Engineer Battalion. The 46th is composed of the 58th CEC and an allied engineer company deployed to the NTC to support the rotational training. These companies come from corps mechanized combat engineer battalions, the Army National Guard, the Army Reserves, and the U.S. Marine Corps to fight as Krasnovians and provide the best possible training for the Army.

Organization

The 58th CEC is organized as a modified table of organization and equipment separate engineer company, with an authorized strength of 184 people. Cooks and the personnel clerk are permanently detached to Headquarters and Headquarters Troop, Regimental Support Squadron, which provides field and garrison feeding services and personnel services to the company. Subordinate elements include three line platoons, an assault and obstacle platoon, and a maintenance platoon. The regiment's two separate companies, the 58th CEC and the 511th Military Intelligence Company, are subordinate to the Regimental Support Squadron of the 11th Armored Cavalry Regiment.

Training

The 58th CEC conducts most of its training on an opportunity basis, with most of it performed as a member of the combined arms team of the 125th GTR or 32nd GMRR. The three line platoons rotate through a training cycle that focuses on mobility, countermobility, and support. Platoon leaders are responsible for most of the tactical planning and coordination. The mobility platoon leader war-games and plans offensive missions, and the countermobility platoon leader handles defensive missions. Each platoon provides assets to the other as needed to execute assigned missions. For example, the countermobility platoon executes flank obstacles in the offense. The support cycle

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platoon executes vehicle services and taskings, which provides time for soldiers to attend schools. Critical to success is that the task organization during training must be identical to that used during NTC battles.

Rotation Schedule

The rotation schedule is based on a four-week training cycle. It begins on a Monday with reception, staging, onward movement, and integration (RSOI) for the BLUFOR (formerly known as "Draw Week"). While the brigade combat team builds combat power by drawing prepositioned equipment, the 58th CEC prepares for the upcoming conflict.

On RSOI days 1-5, vehicles are dispatched, load plans are verified, additional Class IV and V materials are requisitioned (as necessary), and precombat checks and inspections are conducted. On RSOI 4 and 5, certification training for the allied engineer unit is conducted to verify its ability to emplace obstacles, breach, and prepare vehicle fighting positions to the OPFOR standard. On RSOI 5, equipment is prepositioned at a predetermined laager site in the field. During RSOI week, leader's reconnaissances, war games, and tactical exercises without troops in preparation for the rotation are conducted.

RSOI week is followed by training days 0-14. Force-on-force operations are conducted through training day 8 and normally comprise four or five major engagements with the brigade combat team. During training days 9-13, the 58th CEC conducts recovery operations, qualification ranges, and sergeant's time training. The support cycle platoon also conducts "Green for Maneuver" training during this week, where U.S. doctrinal missions are executed to maintain proficiency.

The training days are followed by four between-rotation days, during which we conduct mandatory training, safety briefings, and privately owned vehicle inspections. This is followed by a four-day rest period, returning on Monday for another RSOI week. This makes for an extremely busy schedule with high operating tempo (1,500 miles per year on the M113A2s). However, it is also very predictable, which allows soldiers to make travel plans for rest periods well in advance. The schedule includes leave periods in December and June that are a maximum of two weeks each.

Engineer Planning

A major reason for the success of the OPFOR at NTC is the integration of combat multipliers into every phase of planning. Fighting as a truly combined arms *team* requires that maneuver commanders and their attachments work together to develop a plan that exploits the full potential of all involved in the mission. This plan integrates the engineer effort into the intelligence preparation of the battlefield process, the commander's concept of the operation, the scheme of maneuver, and the scheme of fires. Working as a team enhances the effects of engineer efforts—whether breaching, emplacing obstacles for a defense, or protecting the regiment's flank on a regimental attack.

Mission planning involves coordinating the efforts of five engineer assets with more than 15 vehicles. The mobility support detachment (MSD) is made up of three M113 armored personnel carriers (APCs) and up to two M9 armored combat earthmovers (ACEs). The MSD, the breaching asset of the OPFOR, carries with it the necessary equipment and marking materials to either breach or mark bypasses of both conventional and situational obstacles.

A mobile obstacle detachment (MOD) includes three APCs with M105 trailers that represent Soviet GMZ minelayers. The MOD can surface-lay up to 900 meters of conventional land mines in three rows to a depth of 120 meters. The MOD takes up to 20 minutes to emplace and is usually used to secure an assailable flank.

In defensive operations, the MOD typically is laid after last light to fill in gaps between conventional obstacles. The Soviet UMZ is similar to the Volcano and emplaces a minefield 120 meters deep and 1,100 meters long with a four-hour duration. The Soviet UMZ usually is attached to the advanced guard to build a hasty engagement area but also can be used for flank security or to create a hasty defense against counterattacks once the objective is reached. In the defense, the Soviet UMZ is used to add depth to the obstacle plan or to backstop an enemy breach.

On the offense, planning begins when the regiment issues the operations order the day before a battle. The chiefs of operations and reconnaissance develop up to four possible courses of action to present at the operations order briefing. Based on the courses of action, the regimental engineer task organizes his assets to best support the mission. For a regimental attack, the typical task organization is to have an MSD and Soviet UMZ with the advance guard, an MSD and MOD with the first echelon, and a MOD with the antitank battalion for flank security. However, depending on assailable flanks and the enemy's disposition and style of fighting, the Soviet UMZ also may be attached to the antitank battalion. No engineer support is attached to second echelon forces. Engineers attached to the advance guard will fall in with follow-on forces as they assume the main effort. This flexibility for the MSD to link up with and join a separate MRB ensures continued mobility of the regiment.

After the operations order, the regimental commander, S3, S2, fire-support officer, S3 Air, Military Intelligence company commander, and engineer executive officer war-game each course of action. Targets are designated for the MODs and Soviet UMZ and possible points of penetration are templated.

> **“The success of the 58th CEC, and therefore the success of the regiment, lies in the ability of the squad leader to react to an order and execute the mission.”**

After the war game, information is disseminated to the engineer platoon leaders and the MOD and Soviet UMZ targets are placed on a set of master graphics. After platoon leaders receive this information, they assign squads with targets and responsibilities for each course of action. Because no battle ever goes exactly as it is war-gamed, squad leaders must remain flexible and be able to change their focus depending on developments.

In addition to assigning targets to the MOD and Soviet UMZ, the war game also designates critical points along the route of march where mobility must be maintained. For instance, if a course of action has the entire regiment moving through a single choke point, the MSD with the advance guard will be positioned in that choke point to immediately breach if a FASCAM is dropped to maintain the mobility of follow-on forces. The MSD will then link up with the next element and push forward to the next critical mobility target.

Each engineer asset is under the control of a squad leader, who talks directly with the commander of the MRB to which he is attached. The success of the 58th CEC, and therefore the success of the regiment, lies in the ability of the squad leader to react to an order and execute the mission. Platoon leaders assign squads to MRBs, enforce standards, and help the squad leader achieve mission success.

OPFOR Mobility Operations

Success for an MSD is not to create a single breach but to create several breaches. The MSD must be able to move from one MRB to another, establish communication with the MRB commander, and ensure that the MRB has unchecked mobility.

Due to the bold advance of an OPFOR attack, in-stride breaches are conducted. The aggression and initiative of the breaching force in securing the breach is enough to guarantee safe passage for follow-on forces through the breach. Each MSD APC carries a basic load of 36 traffic cones and nine VS-17 panels, which is enough material to mark three breach lanes. Redundancy is achieved by integrating the allied engineer company into the MSDs. The complete detachment consists of an M9 ACE and three APCs, with a minimum of four soldiers per APC. All three APCs can simultaneously breach lanes through enemy obstacles, which greatly increases the speed at which follow-on forces can advance to the objective.

Enemy conventional obstacles are breached either with the M9 ACE or manually according to NTC rules of engagement. In a manual breach, two soldiers dismount from each APC and move forward through the minefield. After clearing away any fratricide fence, the soldiers run back to their APC while placing pop-and-drops beside each mine. Two minutes after the first pop-and-drop is placed, the charges explode and the breach is complete. The soldiers then exit the APC with lane-marking materials and remove the “destroyed” mines. A complete manual breach with marking materials can be finished in three minutes. Breaching with the M9 ACE takes the same amount of time; however, it is more effective when under small-arms fire.

Breaching scatterable mine (SCATMINE) and Volcano obstacles manually is less effective in maintaining the regiment’s momentum. In manual breaching, a soldier must grapnel through the minefield and run a line main with charges every 30 meters. A manual breach of these types of minefields takes about 40 minutes, which is far too slow to be effective. SCATMINE and Volcano obstacles preferably are bypassed or are breached with an M9 ACE or a mine plow. Typical BLUFOR SCATMINE obstacles are delivered far from any covering force and usually allow an easy bypass on one of the two flanks. After the bypass is found, it is marked the same way as a breach lane—with traffic cones and VS-17 panels.

OPFOR Countermobility Operations

The countermobility support provided by the 58th CEC relies on thorough planning and a well-rehearsed battle drill. The defensive platoon leader for that month and the MRB commander of the defense must develop an obstacle plan that best supports the MRB commander’s intent, minimizes risks, and involves some deception. The platoon leader then makes intent graphics based on the obstacle plan to further refine the plan and give a better picture to the MRB commander and his subordinate leaders.

Linking up early with the overwatching unit is vital for successful defensive preparations. The platoon leader and overwatching MRC commander typically agree on a prearranged location and time to meet. The MRC commander gives the engineer an overview of his intent and shows him the fighting positions, adjacent unit locations, and approximately where he wants the obstacle placed. After this brief-but-thorough meeting, the engineer drives to where the obstacle will start, and the MRC commander goes to the location of his fighting positions. While maintaining radio communications with the MRC commander, the engineer marks out the obstacles. The MRC commander ensures that the obstacles being sited are within direct sight and at the proper distance. This method of siting is the most efficient and effective way to ensure proper obstacle placement.

Maintaining a basic load of Classes IV and V materials for obstacle emplacement is key to a speedy defensive preparation. The 58th CEC maintains a basic load of 2,500 mines, 1,700 rolls of concertina wire, and 3,000 pickets—all hauled with organic assets. The basic load is enough for one standard MRB-sized security zone or defense.

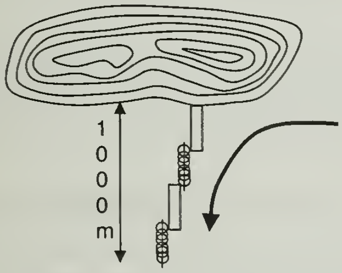
Wire and pickets are hauled with a palletized load system (PLS) and heavy expanded-mobility tactical truck (HEMTT) cargo, respectively, and Class IV materials are dropped off the truck as it drives the line of the obstacle. Land mines are hauled in M105 trailers behind the APCs and emplaced similar to a MOD. The HEMTT cargo with the pickets is the first to drive the line of the obstacle, with a man on top dropping pickets at correct intervals. After the pickets are dropped, personnel in from one to three APCs lay mines parallel to the line of pickets. Simultaneously, the PLS follows the pickets and drops concertina wire. Using this method, a trained platoon can emplace a 300-meter minefield in 30 minutes and 300 meters of triple-standard concertina wire in 45 minutes. This efficiency allows the MRB commander the luxury of using deception in his obstacle plan. For example, he can leave avenues of approach open until the night before the expected attack and emplace obstacles in the dark when BLUFOR scouts cannot gather good intelligence.

Obstacle Design

The OPFOR engineers use U.S. doctrinal obstacle intents to shape the battlefield: block, turn, fix, and disrupt (see Figure 1). The design of these obstacles, however, is peculiar to the OPFOR. The most commonly used obstacle designs are the turn and fix. The design of the

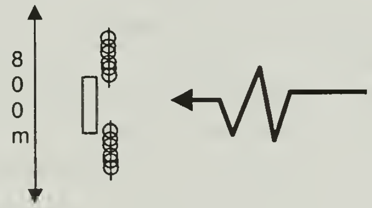
Obstacle Designs

Turn Group



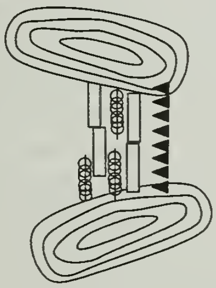
Consists of two 3-row, 300-meter minefields and two triple-standard concertina, 300-meter wire obstacles.

Fix Group



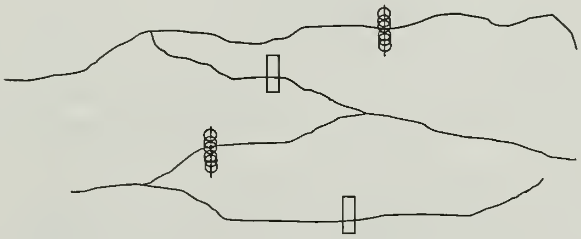
Consists of one 3-row, 300-meter minefield and two triple-standard concertina, 300-meter wire obstacles.

Block Group



Constructed across narrow mobility corridors in such a manner that an enemy force must breach at least three individual obstacles, which preferably are a combination of mines, wire, and earthworks.

Disrupt Group



Normally consists of a series of point obstacles emplaced astride trails and roads within the obstacle group.

Figure 1

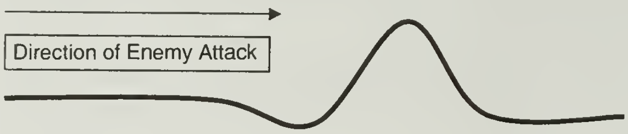
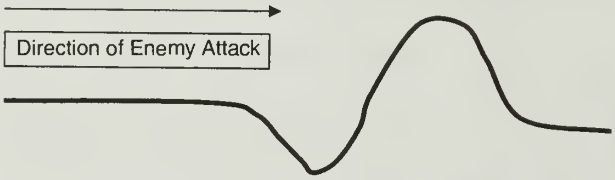
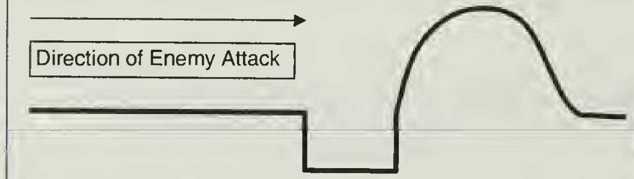
Categories of Tank Ditches	
Category I  	A berm approximately 6 feet high. One D7 dozer can emplace 100 meters per hour, making it the most expedient type of tank ditch used. From a distance of more than a few hundred meters, it has the appearance of a true antitank ditch and has stalled entire task forces for over an hour. It is not a formidable obstacle and can easily be driven over by an Abrams or Bradley tank; however, even after this is discovered by the approaching enemy, it is breached at most in two locations. A Category I ditch two kilometers long can effectively close a maneuver corridor to elements larger than a company team.
Category II  	Includes a V-ditch with the berm. The added ditch adds 2 feet of height and an increased angle to the berm on the enemy side. Category II ditches force Abrams or Bradley tanks to make multiple attempts to breach and will force the commitment of engineer elements for a successful breach of the obstacle. A single D7 dozer can build 50 meters of Category II in an hour, restricting overall length to less than 1 kilometer per night.
Category III  	A true antitank ditch. Because it is slow to emplace, it is rarely used. When it is used, the length rarely exceeds 200 meters. This ditch is used only when there is not enough Classes IV and V materials to block a major avenue of approach.

Figure 2

obstacle groups is static; additional length is accomplished by adding more groups.

Note that obstacle preparation is a regimental activity. When needed, the MRBs provide personnel to assist. Additionally, after each defensive battle, soldiers in the regiment push forward to collapse wire obstacles and stack mines to facilitate rapid battle cleanup. This commitment on the part of maneuver forces goes a long way toward sustaining the high morale and esprit de corps of the engineer soldiers and truly makes for "One Team, One Fight!"

Earthworks

In addition to conventional obstacles, the OPFOR incorporates earthworks in its obstacle plan. Figure 2 shows three categories of tank ditches formed by earthworks.

To minimize idle bulldozer hours, all three categories usually are emplaced at night, which has two major benefits: increased safety and deception. Focusing bulldozer efforts on earthworks during limited visibility allows survivability work to be completed during daylight, which decreases the chances of rollovers and potential injuries or death to soldiers. Also, by building earthworks at night after the scouts' last-light read, we take away the enemy's ability to make decisions based on true battlefield conditions. A typical scenario is that on the morning of the battle, the enemy wakes up to a huge antitank ditch or berm that was not there the night before.

OPFOR Survivability Operations

Survivability work is best conducted simultaneously with obstacle emplacement. This practice ensures that each vehicle crew is aware of obstacle locations and is in the best position to cover the obstacles. A tank crew cannot afford to wait at their position all day for a bulldozer. Therefore, the 58th CEC devised a simple yet effective way to site holes (see Figure 3, page 33). Two pickets are lined up like the sights of a gun to show the orientation of the fighting position. Bulldozer operators then can easily see how to dig the hole. The person siting the position attaches a piece of engineer tape on the front picket that states the vehicle bumper number and type of position. The tape makes the site easier to see from a distance and lets the engineer command-and-control element know whom to contact when the hole is ready to proof.

Every bulldozer operator and combat vehicle crew in the regiment knows this method of siting, which ensures that survivability work is done quickly and minimizes idle bulldozer time. Additionally, each vehicle commander must personally proof and mark his position to standard before the bulldozer moves on. This ensures that the position meets his requirements and is not a hazard to himself or others.

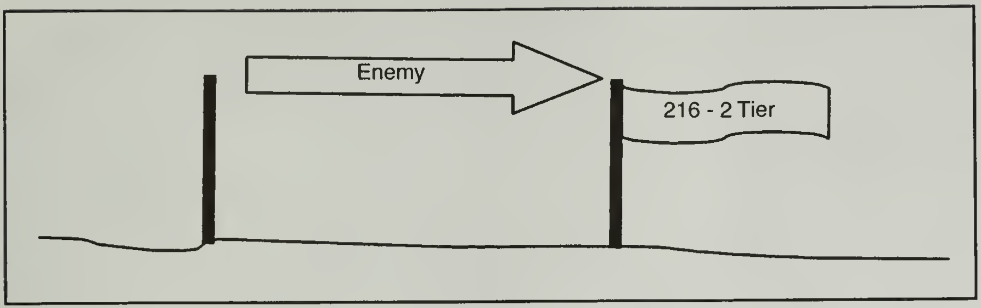


Figure 3

OPFOR Deception Operations

Deception operations are included in every mission on the NTC battlefield. Every member of the combined arms team employs some type of deception measures, and engineers are no exception. Engineers are involved primarily in emplacing deception obstacles and fighting positions.

Mobility Deception

Engineer assets often are used in the offense to deceive the enemy as to the location of the regiment's main effort. For example, in a regimental attack, the 58th CEC often includes armored vehicle-launched bridging with an enveloping detachment to conduct a demonstration toward a portion of the battlefield where the enemy has emplaced tank ditches. The demonstration has the effect of falsely confirming a situation template that predicts a breach at that point on the battlefield. In turn, forces in that portion of the battlespace become fixed, while the regiment penetrates the enemy defenses on the opposite flank.

Countermobility Deception

In the defense, or even in a meeting battle, deception minefields have a high payoff for the OPFOR. To accomplish this effect, engineers and scouts place fake mines and tilt rods in choke points or along high-speed avenues of approach. Although these deception minefields can quickly be identified as harmless, the initial reports sent higher often reverberate through the command-and-control channels for some time. This causes confusion at high levels and often results in false assumptions about the location and composition of the OPFOR main defensive positions. Deception minefields also may compress forces, making them a target-rich environment for indirect fires and long-range antitank fires.

Another method of countermobility deception is to construct deception berms, which require minimal blade hours and are easy to penetrate. Deception berms are targeted against reconnaissance elements watching from long-range observation posts, because they have difficulty distinguishing these berms' ground signature from the real thing. Deception berms are easily identified when ground forces or reconnaissance elements approach them.

Survivability Deception

When blade time is available, engineers prepare deception survivability positions, which may be anything from a scrape to a one-tier fighting position. All OPFOR graphics include deception battle positions, which are constructed as if they will be occupied (they are tactically dispersed and mutually supporting). Regimental deception crews then place turrets and heat sources in the positions to deceive long-range and thermal observation. If the positions are dug to a one-tier level, vehicles will occupy them at some point to further deceive enemy reconnaissance.

Conclusion

The 58th Combat Engineer Company is a highly trained, seasoned organization that must accomplish its mission without fail—month after month—to provide the U.S. Army with the best training possible. Without the support of allied engineers and regimental troopers, the level of success the 58th Combat Engineer Company enjoys would not be possible. We are truly one team with one fight.

Captain Law is an exchange officer to the Canadian Forces School of Military Engineering at Canadian Forces Base Gagetown in New Brunswick, Canada. Previous assignments include B Company Commander, 554th Engineer Battalion, Fort Leonard Wood, Missouri; observer/controller, Operations Group, Fort Irwin, California; and Company Commander, 58th Combat Engineer Company, 11th ACR, Fort Irwin, California. CPT Law is a graduate of the Engineer Officer Advanced Course, the Junior Maintenance Officer Course, and the Combined Arms and Services Staff School. He holds a bachelor's degree from the University of Idaho.

First Lieutenant Ferdon was the Operations Officer for Company A, 682nd Engineer Battalion, Minnesota National Guard. He previously served as special projects engineer for the U.S. Support Group, Haiti; and platoon leader, 58th Combat Engineer Company, Fort Irwin, California. 1LT Ferdon holds a bachelor's degree from the University of Wisconsin–Stevens Point and is a graduate of the Engineer Officers Basic Course.

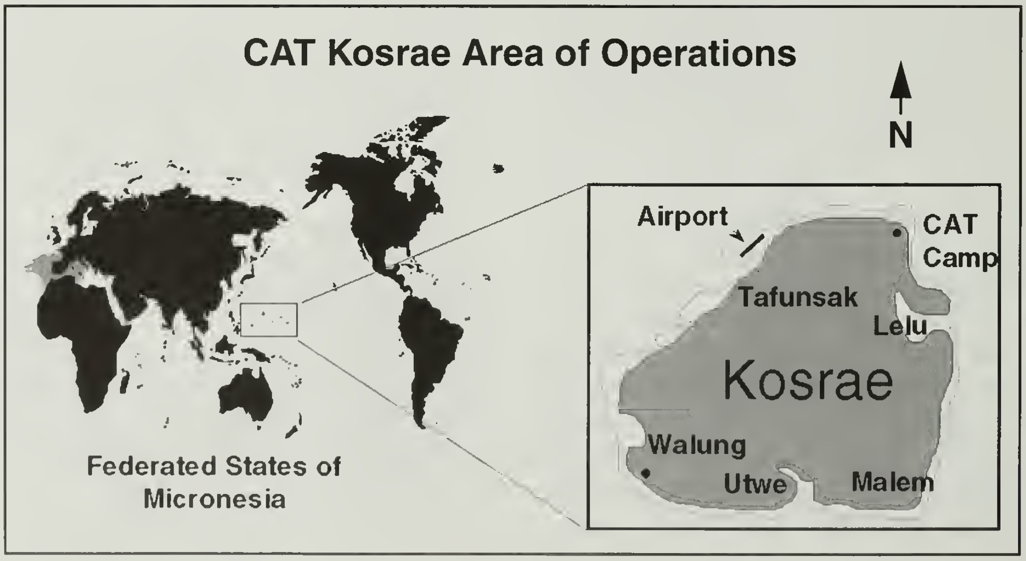
Civic Action Teams in Kosrae

By Captain Noah Webster

A small unit of 13 soldiers from Hawaii's 84th Engineer Combat Battalion (Heavy) made up Civic Action Team (CAT) 84-53. On 4 March 1999, the team began a 6-month deployment to the island of Kosrae—one of the four island states of the Federated States of Micronesia (FSM). The other three are Yap, Chuuk, and Phonpei, with the latter being the most heavily populated (8,000 people) and the site of the nation's capital and the U. S. Embassy. Located in the Pacific Ocean east of the Philippines, the islands were part of a trust territory established in 1943 after their liberation from Japanese occupation. This relationship changed when the islands joined together and the Compact of Free Association was signed with the United States in 1981. The 20-year agreement provides defense and nation-building support for the FSM. Negotiations began this fall for a successive treaty.

CAT 84-53's unit designation explains most of its mission and history. The 84th Engineers stamps its teams with "84"; there have been 53 such teams from the 84th (the first one was fielded in Kosrae in January 1980). Thus the group of soldiers that deployed in March is called CAT 84-53.

In addition to its civic action projects—primarily construction—CAT 84-53 was involved in apprentice training, medical assistance, and community relations. The first teams to engage in civic action projects were the Navy's Seabee technical assistance teams deployed to Vietnam, Thailand, and Central and South America in the 1960s. Civic action teams in the Federated States of Micronesia, which fulfill the requirements of the Compact of



Free Association, are a joint mission administered by the USCINCPAC Detachment, Civic Action Teams (DET CAT), in Guam. This detachment assumes operational control and logistical support for the teams. Permanent teams are on each of the four islands of Micronesia. The Army, Navy, and Air Force each man one island, and the services take turns staffing the team for the fourth island.

The Army supports the island of Kosrae. The Alaskan Special Troops Battalion and the 84th Engineers alternate sending a team every six months. Similarly, the sponsoring company in the 84th Engineers varies from team to team. The Bravo Company commander maintained administrative control over CAT 84-53 and served as a point of contact for family issues, administrative actions, and soldier readiness. The 84th Engineers selects soldiers based on the recommendation of the civic action team officer in charge and the needs of the battalion. Due to the six-month duration of the tour, the battalion tries to send only experienced volunteer soldiers.

Looking past the name, much more can be learned about CAT 84-53 from its deployment preparations, organization, and construction projects.

A CAT 84-53 soldier and an apprentice install a sidewalk culvert.

Deployment Preparations

The team focused on two major areas before deploying—soldier readiness and family readiness.

Soldier Readiness

Since the civic action projects were mainly construction projects, the 84th Engineer Battalion's chain of command required that CAT 84-53 complete a section of a block building to receive certification on vertical construction skills. The team's electrician and plumber also worked with the Schofield Barracks Department of Public Works before deploying.

To verify equipment operation skills, members of the team helped clear and level a firing point. Mechanics trained on skills necessary for deployment, to include the Navy maintenance system, which DET CAT uses, and outboard motor repair.

Family Readiness

A family support group was the primary means of taking care of families during the team's deployment. During the group's first meeting, the officer in charge described such things as the island, the mission, and means of communication. Each family received a packet containing more detailed information. Once deployed, team members could still help care for their families. A telephone line was run to each room, so that team members could talk privately. Soldiers who wanted Internet accounts could "chat" or e-mail their families economically. In addition, families received regular newsletters about team activities and quality-of-life issues.

Organization

Each soldier's skills and experiences were vital to team success at the camp and on project sites. The camp was a mini-installation and was self-sufficient in many ways. The plumber prepared potable water using a water purification unit. The electrician was proficient at activating the camp generator, because the island's power regularly goes out. He installed equipment, including wiring a tire machine, plasma welder, and table saw for the camp. The plumber and electrician made many emergency repairs at the camp and around the island.

Three maintenance soldiers kept the vehicles operational. Severe weather and high operating tempo increased the difficulties of maintaining equipment, but the main challenges were the mechanic-to-equipment ratio and the lack of on-island higher-echelon support. There were 17 pieces of major engineer equipment, including a D5 Caterpillar® bulldozer, 426C Caterpillar® backhoe, CP433C Caterpillar® roller, 520B 10K Dresser® bucket loader/forklift, and 670A John Deere® grader. Since one of the maintenance soldiers was the team's welder, two engineer mechanics maintained this equipment in addition to the team's two 5-ton dump trucks, three pickup trucks, two 60KW generators, and a tractor-trailer.

Since the DET CAT uses the Navy maintenance system, the two Army mechanics had to learn a similar but different system for maintaining equipment. With no higher-echelon maintenance to help out, they either performed the maintenance themselves or sent the equipment back to DET CAT in Guam for repairs. Repair parts were also a problem, because there was no higher-level authorized stockage list to draw from. Despite these challenges, the team's equipment was in constant demand from people on the island because it was well maintained.

The team's supply clerk collected supply requests, researched and forwarded the requests, and issued and accounted for supplies. Supply communication to DET CAT was through a Microsoft Access database that was e-mailed back and forth. The team updated requested items and DET CAT updated their statuses. DET CAT reviewed the database the team sent and then requested items through the standard Navy system.

Supplies were consolidated on Guam and sent by C-130 to Kosrae every six weeks. The team's pallet inspectors led the resupply mission. During the week before the flight, they palletized items to return to Guam. Since C-130 crews rotate constantly, most have never flown to Kosrae. An inspector would attach a "follow me" sign to the rear of a truck, drive onto the runway, and guide the plane across the tarmac, where the pallet exchange took place. One of the happiest times on the camp was when the trucks returned from the airport with supplies—materials for projects, new tools, repair parts, and Class VI items.

The nurse practitioner helped ensure that soldiers stayed healthy. She advised the team officer in charge about potential dangers, taught classes, tested the water for contamination, and maintained an extensive on-camp clinic.

Other duties to keep the camp running smoothly—such as safety, environmental compliance, and equal opportunity—were delegated to various team members. The team lacked access to support agencies in Hawaii. Soldiers could contact the rear for assistance, but camp improvements began with the initiative of soldiers on Kosrae. There was no Department of Public Works or Housing Agency with which to file job orders for building repairs. One team member maintained a file of all camp buildings and inspected them for deficiencies. Then he requested materials from the supply clerk and fixed the problems himself or with the help of teammates.

The team was broken into four operational groups to perform work outside the camp:

A member of the team installs floor tile in a renovated office area.

- Vertical section (carpenter/mason, plumber, and electrician)
- Horizontal section (equipment operator and supply clerk)
- Maintenance section (two mechanics and a welder)
- Headquarters (OIC, NCOIC, and nurse practitioner)

Construction Projects

As deployed engineers, life rotated around construction projects. Daily operations impacted the work from day to day, and project scheduling impacted the long-term weekly and monthly scheduling. Each day the soldiers had an opportunity for exciting and diverse work. Much of the time, the team worked on Saturdays, but island custom dictates that no work occurs on Sunday. This precludes just about everything except attending church services and visiting with friends.

Generally, two projects ran concurrently. Due to the size of the team, everyone cross-trained, and at times the entire team worked together, such as during concrete placement. This allowed soldiers to work with different team members at various locations on the island. Proper coordination was necessary, so that additional duties did not interfere with a soldier's work on a project site. This was a key point when considering the importance of additional duties. For example, the plumber must prepare drinking and bathing water for the camp before moving to a project site.

The initial projects, which lasted about six weeks, were set up by the previous CAT team. CAT 84-53 began work immediately on three projects, because plans and material were on hand. Additional projects were approved by DET CAT and the Civic Action Coordinating Committee, which is composed of town mayors and representatives from the Kosraen state government. All construction was based on the customers' plans and constructed with materials that they purchased.

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The following obstacles sometimes delayed project schedules:

Rain

Rain is a factor in any activity on Kosrae. During the first six weeks that the team was on the island, it rained an average of 5 inches a week. Roadwork and concrete placement were difficult to plan and execute. The importance of drainage became magnified, because every project had the potential to be inundated. Poorly planned drainage generated many of the project requests. If the drainage plan for the project in progress was not successful, then it was fixed before more work was performed.

During the summer, the rain decreased substantially; however, it was still a factor in planning since each project must be able to withstand the rainy season. Equipment and vehicles were constantly battered by rain. Each team was required to paint two vehicles during their deployment. CAT 84-53 painted its two 5-ton dump trucks and applied rust inhibitor to its entire fleet. The team also painted every structure on the camp except for the two newest buildings.

Resources

Resources are limited on Kosrae. Two hardware stores stock a limited amount of goods, but if necessary supplies could not be found in them, then the project was delayed until the next resupply flight.

On a larger scale, it was difficult at times for the state to fund projects. If money was unavailable, work could not start. Projects must be planned well in advance and thoroughly coordinated with the Kosraen government's many levels.

Accomplishments

The diversity of projects and the additional duties and missions brought variety and excitement to each day for CAT 84-53. The team's many projects greatly improved the socioeconomic condition of Kosrae. Much of the work was especially beneficial to the island's children. In addition, the team trained apprentices from the local labor force at project sites to prepare them for construction or maintenance jobs with civilian companies. The apprentices will continue to improve the island after the team leaves.

The first project was to renovate offices and a computer classroom for the *Upward Bound Program.* This program, which prepares high school students for college, is only eligible to children whose parents do not have college degrees. The team improved a 1,000-square-foot area and established a new standard for the island's offices.

During summer school, three soldiers taught a communications/speech class to high school seniors in the *Upward Bound Program.*

The team also constructed a 15- by 24-foot block latrine for a Kosraen high school, which had only one water closet for its 500 students. The new latrine has three water closets for males and three for females. The succeeding CAT team will complete some finish work in the first latrine and build a second one.

CAT 84-53 supported a group of 100 high school freshmen, who walked the entire circumference of the island and learned practical skills and island history. Team members taught classes and provided medical support and transportation.

An 80- by 50-foot basketball court was built at Mutunte to help keep children constructively occupied and deter drug abuse and crime. Initially, drainage in the area was poor and the road to the court was dangerous. The team hauled 650 cubic yards of material to establish proper drainage, raised the pad 2.5 feet, and repaired the access road. The project was a special one, because 20 townspeople assisted in the concrete placement. This made the project a community relations event and ensured that enough manpower was on hand to properly complete the project.

The equipment section of the team built an 800-meter road to the top of a hill that has a beautiful view. The succeeding CAT team will build a park there to help promote tourism. The best unpaved road on the island, it demonstrates to the island's leaders the proper use of coral and drainage on roads.

The team completed a sidewalk culvert and awning project at the airport. The culverts effectively channel rainwater and increase safety for travelers walking to and from planes. The awning prevents water damage that airport offices regularly sustained in rain storms.

CAT 84-53 helped build a sea wall at Malem to protect the beach from high surf that arrives in August. The team traveled a 2-hour round-trip route to haul 125 cubic yards of rock.

The medical program was a great help to the island. Each week the team medic made an average of four visits to local municipalities and saw approximately 50 patients. The medic taught numerous health and nutrition classes, gave general health counseling to patients, and consulted with most island health care providers.

The team developed plans for and renovated the 20- by 30-foot children's ward of the hospital. Kosraen children now have a clean, quality place to recover. The hospital project also included moving a door that opens an alternate route for stretcher access to the X-ray room and limits traffic through a sterile hospital hallway.

An aerobics program for women drew 40 participants who met three times a week. A local doctor was trained and now leads the group. In addition, the team conducted physical training for island athletes twice a week. These athletes competed in this year's South Pacific Games.

Once a week, two soldiers broadcast a radio show that plays music and promotes civic action team events.

Lessons Learned

The most important lesson that CAT 84-53 learned was to know

(Continued on page 40)

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WHAT EVERY WARRIOR SHOULD KNOW ABOUT MAPS

By Captain Dirk E. Plante

After just a short time in Korea, I've discovered that many warfighters are unaware that a great deal has changed in the past few years when it comes to maps. Not that it's necessarily their fault; many people just assume that maps will be there when they are needed—that they will show up somehow, someway. However, that isn't the case.

Issues

I have identified ten items that every warrior should know about maps. As the Army's map experts, en-gineers need to educate their fellow warriors on these ten issues. I have also included lessons learned or procedures used in Korea to illustrate some of the points.

1. Engineers are no longer responsible for map distribution.

On 1 April 1998, the Defense Logistics Agency (DLA) took over the mission of map distribution. Some engineers may find this hard to accept, but it makes good sense. Maps are a supply commodity, and logisticians handle supplies.

2. DMA is now NIMA.

Before DLA began distributing maps, the responsibility belonged to the National Imagery and Mapping Agency (NIMA). NIMA was formed on 1 October 1996 by combining the Defense Mapping Agency (DMA), the Central Imagery Office (CIO), the National Photographic Interpretation Office (NPIC), and the Defense Dissemination Program Office (DDPO). Also included were imagery-related elements of the Central Intelligence Agency (CIA), the Defense Intelligence Agency (DIA), the National Reconnaissance Office (NRO), and the Defense Airborne Reconnaissance Office (DARO).

3. There are maps other than TLMs and JOGs.

For ground forces, the two most popular map scales are the 1:50,000 topographic line maps (TLMs) and the 1:250,000 joint operations graphics (JOGs). NIMA produces a wide variety of products that range from a 1:135-million-scale world map to a 1:7,000-scale city map and some even larger-scale products. Products can be lumped into one of four categories: aeronautical, hydrographic, topographic, and digital. Since so many different types of products are available besides paper maps, the name of the entire family of products has changed from mapping, charting, and geodesy (MC&G) to geospatial information and services (GI&S).

There are thousands of GI&S products that deal with Korea alone. The series of 1:50,000-scale TLMs covering the peninsula includes more than 400 map sheets.

4. Maps have national stock numbers (NSNs).

NSNs are 13-digit numbers unique to each supply item. Under DMA's distribution, not all products carried NSNs. Now, as NIMA updates GI&S products, DLA assigns NSNs to them. (Even classified GI&S products have NSNs, although not all units can order them.) Only a few items still lack NSNs. As NIMA produces a new edition of a particular product, the NSN is printed on it. On map sheets, it is normally found in the lower right-hand margin.

The NSN should not be confused with another number normally found on GI&S products—the NIMA-assigned reference number (formerly known as the DMA reference number). When NIMA was responsible for distribution, this reference number was used to order the product; today NSNs are used. NSNs are randomly assigned numbers, but NIMA reference numbers are based on an orderly numbering scheme. Therefore, adjoining map sheets will have adjoining NIMA reference numbers but may not have successive NSNs.

The island of Cheju, located off the southwestern coast of Korea, is covered by two 1:100,000-scale map sheets, with NIMA reference numbers of L654X3412 and L654X3512 (see *figure). The corresponding NSNs are 7643-01-424-5709 and 7643-01-424-6286. While the NSNs in this example are not successive, some adjoining products have successive NSNs. It depends on the order in which NIMA requests NSNs from DLA.*

5. When GI&S products are updated, their NSNs and NIMA reference numbers do not change.

After NIMA assigns a reference number and DLA assigns an NSN to a product, it will always be identified by those numbers—even when the product is updated. What changes is the edition number of the product. When a GI&S product is updated, the edition number increases by one from the previous edition number. When a product is ordered through the supply system using the NSN, logisticians fill the requisition with the most current edition. Outdated editions are never issued. When a new edition of a product is stocked, the previous edition is destroyed. This procedure ensures that the most current information is provided to the field.

6. Map unit basic loads (UBLs) must be maintained.

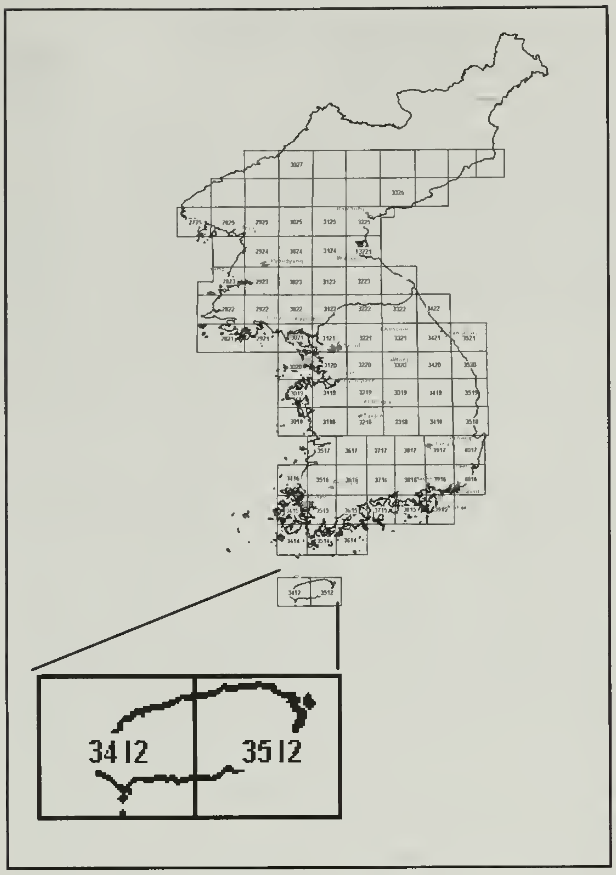
Maintaining map UBLs is just as critical as maintaining UBLs for food and ammunition. To help keep UBLs current, DLA publishes catalogs of the products it stocks. Additionally, it publishes updates (called *Bulletin Digests*) several times each year to provide information on current editions of a product and the date the edition was produced. The unit's map custodian should be thoroughly familiar with these publications.

To ensure that they have the most current edition of GI&S products in their UBL, units should set up an automatic distribution account with DLA. Then when DLA receives new editions of products that are on the unit's automatic distribution listing, DLA will ship them to the unit. The unit should destroy previous editions and notify subordinate units to do the same. Classified and unclassified/limited distribution products require special destruction methods based on their classification.

Due to environmental concerns, we are looking into a program to recycle paper products rather than burn them. Before selling the material to a civilian contractor for recycling, the maps would be shredded by U.S. assets to ensure that map data is not legible.

7. GI&S products may be obtained in several ways.

Using standard supply procedures (providing an NSN to the supply sergeant) to obtain maps is usually adequate for small units. However, other avenues are available. DLA has a web site that allows units to order GI&S products on the Internet. DLA and NIMA also maintain 24-hour hotlines and e-mail addresses where units can obtain information or order products. Higher-level staffs supporting units during a crisis or contingency normally use these options. All GI&S products are Class II, expendable, nonrepairable, nonrecoverable items of supply, issued at no cost to the requestor.



8. Know what datums are and what they do.

Datums are base references for positioning a coordinate system's grid lines. They ensure that artillery hits the correct target, that link-ups are made at the right terrain or topographic feature, that adjoining units properly coordinate area boundaries on the battlefield, etc. Differences in datums are the result of various attempts to develop a mathematical model of a portion or the entire surface of the earth. Because the earth is not a perfect sphere, many mathematical models have been developed to express that shape.

In Korea, the World Geodetic System 1984 (WGS 84) is the only datum allowed in military operations. This prevents mishaps due to positioning errors, although it does not eliminate human error in reporting incorrect coordinates. Providing a grid coordinate from a Tokyo Datum-based map would introduce an error of more than 750 meters when comparing the same location on a WGS 84 map. The warfighting commander in chief in Korea directs the use of only one datum, because all GI&S products for Korea produced by NIMA have a WGS 84-based coordinate system. This is not the case in all areas where the Army may operate. To make the transition to WGS 84, millions of older Tokyo Datum products were destroyed to prevent their accidental use. The datum on Republic of Korea-produced GI&S products is labeled "Korean Geodetic System 1995 (KGS

95)," which is the same datum as WGS 84.

9. Know the map experts.

NIMA is the map expert and can provide training that units need. The National Imagery and Mapping College (NIMC) at Fort Belvoir, Virginia, is the training arm of NIMA. Within NIMC is the Defense Mapping School (DMS), which provides training to soldiers in GI&S-related MOSs in the Army and other services. Much of this training takes place at Fort Belvoir, but DMS also offers on-line, self-tutorial practical exercises (PEs) and mobile training teams (MTTs). Both PEs and MTT courses can be requested through GI&S officers.

In Korea, an MTT visits annually, primarily because of the rapid changeover of personnel but also to provide the newest training available. Dozens of installations are spread across the peninsula, so training is consolidated at a few large installations. Getting MTT support is never a problem; however, getting units to attend training they committed to months earlier can be. One way to alleviate that problem is for units to include this training on their long-range training calendars, provide a by-name list of who will attend, and remind commanders and their staffs of the upcoming training. Additionally, an executive one-hour overview of the training should be given to commanders a month before the scheduled event. If commanders know what type of training will be conducted and how it benefits their soldiers, the training should receive the command emphasis it needs.

10. Annex M contains necessary information about GI&S products.

Although it is generally the responsibility of the intelligence staff (the S2, G2, or J2) or operations staff (the S3, G3, or J3) to produce Annex M of an operations plan or order, engineers normally do the work. The annex, which contains information needed to ensure timely and accurate GI&S support for an operation, identifies available GI&S products. Since maps and other GI&S products are not available at all scales for all areas of the world, warriors must identify specific requirements to the GI&S officer, who will forward it through the chain of command to NIMA.

Conclusion

Much has changed in the world of maps in the last few years. We've gone from using paper maps taped to a map board to displaying digital maps during briefings and inside combat vehicles. Products have evolved from mapping, charting, and geodesy products to geospatial information and services products. The Department of Defense and the Army have reassigned the mission of GI&S product distribution. But something that will never change is the need to keep warfighters up to date on what is happening in the engineer community.

Captain Plante is the GI&S Officer for U.S. Forces, Korea, at Yongsan, Seoul, Korea. Previous assignments include deputy chief, Topography Division, Defense Mapping School, Fort Belvoir, Virginia; and commander, B Company, 37th Engineer Battalion (Combat)(Airborne), Fort Bragg, North Carolina.

Sources:

1. Joyce Forbes, NIMA Geospatial Liaison to PACOM, Camp Smith, Hawaii.
2. Sid Ikehara, DLA Map Support Office, Hickam Air Force Base, Hawaii.

(Continued from page 37)

the island well—its rain and resource problems and its people. Because of the Kosraen culture, working with the various island committees, offices, and businesses was sometimes difficult. It was important to adhere to local customs and speak the language. For example, Kosraens have a strict view of working on Sunday, and anything except going to religious services or visiting with friends is considered work. Tourists and others from off the island can break the tradition if they do so subtly. However, the team earned much respect by never testing the limits of the custom.

Using the Kosraen language had daily, direct benefits. It provided a good first impression and formed the basis for lasting friendships.

A Positive Experience

The organization, deployment preparations, and construction projects of CAT 84-53 describe the workings but not the importance of the team. When the deployment ended, the team had accomplished much. Soldiers were better trained both as engineers and as people. Their engineering skills were improved because of the quantity and variety of work.

Cultural experiences received from interacting with the Kosraen people were positive for each member of the team. Relations with the people of a foreign nation improved, as did their quality of life. Because of the team's accomplishments, Aaron Sigrah, special assistant to the Governor of Kosrae, declared that it was a "wo" CAT. "Wo" is the Kosraen word for "good." CAT 84-53 is proud to be known as a good civic action team.

Captain Webster led Civic Action Team 84-53. He has served as platoon leader and executive officer for Bravo Company, 84th Engineer Combat Battalion (Heavy). CPT Webster is a graduate of the United States Military Academy with a major in mechanical engineering.

PERSCOM Notes

By Sergeant Major Teressa Fillmore

The Assignment Process

"I've done what the Army has asked of me, now I need the Army to do something for me." "I plan to retire in that area." "He/she is the only one with the necessary background to do the job." "Why am I moving instead of SGT Jones? He has been here two months longer than I have."

Do those statements sound familiar? We hear those and similar comments daily in the Engineer Branch. Many soldiers need to know just how assignments are made. Believe me, we don't use a dartboard with installations listed on it! Our primary mission at PERSCOM is to fulfill the needs of the Army. The major factors affecting how soldiers are selected are unit-fill priorities and available personnel.

The Army's fill priority has three levels. *Fill Priority 1* is to fill units to 98-100 percent by military occupational specialty (MOS) and grade. These are the Army's highest priority units or assignments. Assignments are Personnel Priority Group (PPG) 1 and 2 units/duties, such as recruiters, drill sergeants, National Training Center-Operations, and Active Component/Reserve Component positions. *Fill Priority 2* units are filled 98-100 percent in the aggregate (meaning total numbers; matching MOS and grades are not required). These are the PPG3 assignments such as Korea; 1st Cavalry Division, Fort Hood; 82nd Airborne, Fort Bragg; 101st Air Assault, Fort Campbell. *Fill Priority 3* units are the remainder of the force. Some of these PPG 4-9 assignments are the 1st Armored Division, Germany; 1st Infantry Division, Germany; and the 10th Mountain Division (Light Infantry), Fort Drum.

This information means that when you (an E712B soldier) want to be assigned to Fort Leonard Wood, Missouri, and you know that installation is short seven E712B soldiers, you may not necessarily be assigned there. This could be because Fort Leonard Wood (except for instructor and drill sergeant positions) is a Fill Priority 3 installation. Instead, you may be assigned to Fort Hood because the 4th Infantry Division is a Fill Priority 2 organization—even though it has a shortage of just two 12B40 soldiers.

The bigger reason why you may not be assigned where you want or why you are reassigned is the "available personnel inventory" (faces to spaces). Just because you and another soldier are the same primary MOS and grade doesn't mean that the soldier with longest time on station will PCS first. That is because, at any time, a large number of soldiers are not available to move. Reasons why follow:

- Deployment or redeployment. Units/soldiers are "fenced" prior to deployment and "stabilized" after redeployment. Redeployment stops us from placing a soldier on unaccompanied tours for a 12-month period.
- Reenlistment options that prevent the branch from moving a soldier for as long as two years.
- Stabilization for compassionate reasons or schooling (Battle Staff Noncommissioned Officer Course, 1st Sergeant's Course, etc.).
- Uniform Code of Military Justice actions.
- Retention control points, mandatory retirement dates, or Declinations of Continued Service.
- Enrollment in the Married Army Couples Program. We try to keep soldiers stationed together when possible.
- Prerequisites of an assignment, such as a security clearance or specialized training/background.

The Homebase Advance Assignment Program (HAAP) is another vital program. Most soldiers regard HAAP as a "promise" of assignment location upon return from a short-tour area. While this belief is justifiable, sometimes we must notify a soldier that his HAAP assignment has been changed. This decision usually is based on the strength of the HAAP installation or, more accurately, the overstrength of the HAAP installation. A 12-month tour is a long time, and soldiers at the HAAP installation get promoted or soldiers are assigned there for compassionate or other reasons. Actions such as these affect the strength of the installation and may require us to change the HAAP of an inbound soldier. We know that changing a HAAP can create a hardship or change in plans for the soldier and his family, and we strive to make HAAP changes as infrequently as possible. We notify the soldier in ample time of the requirement to change the HAAP and offer at least three alternate assignments.

Another issue is retirements, both mandatory and voluntary. Many soldiers wish to be assigned to a particular location based on their plans to retire in that area. A major problem with this is that often the soldier is not close to his mandatory retirement date, and unit strengths do not support sending the soldier there. We cannot make assignments based on a soldier's "intent to retire," especially when the soldier may serve two or more years. When a soldier returning from overseas is within one year of mandatory retirement, we give full consideration to a request for assignment in the retirement area. Even then, we cannot always fulfill their request.

I hope that this information explains the many challenges you face when requesting a specific assignment. You can do your part by ensuring that your personnel records are accurate and by notifying the Engineer Branch (in writing) of significant changes in your situation that may affect assignments. The Engineer Branch is committed to fulfilling the needs of the Army and taking care of soldiers and their families. For additional information, call commercial (703) 325-4824 or DSN 221-4824.

Sergeant Major Fillmore is sergeant major of the Engineer Branch.

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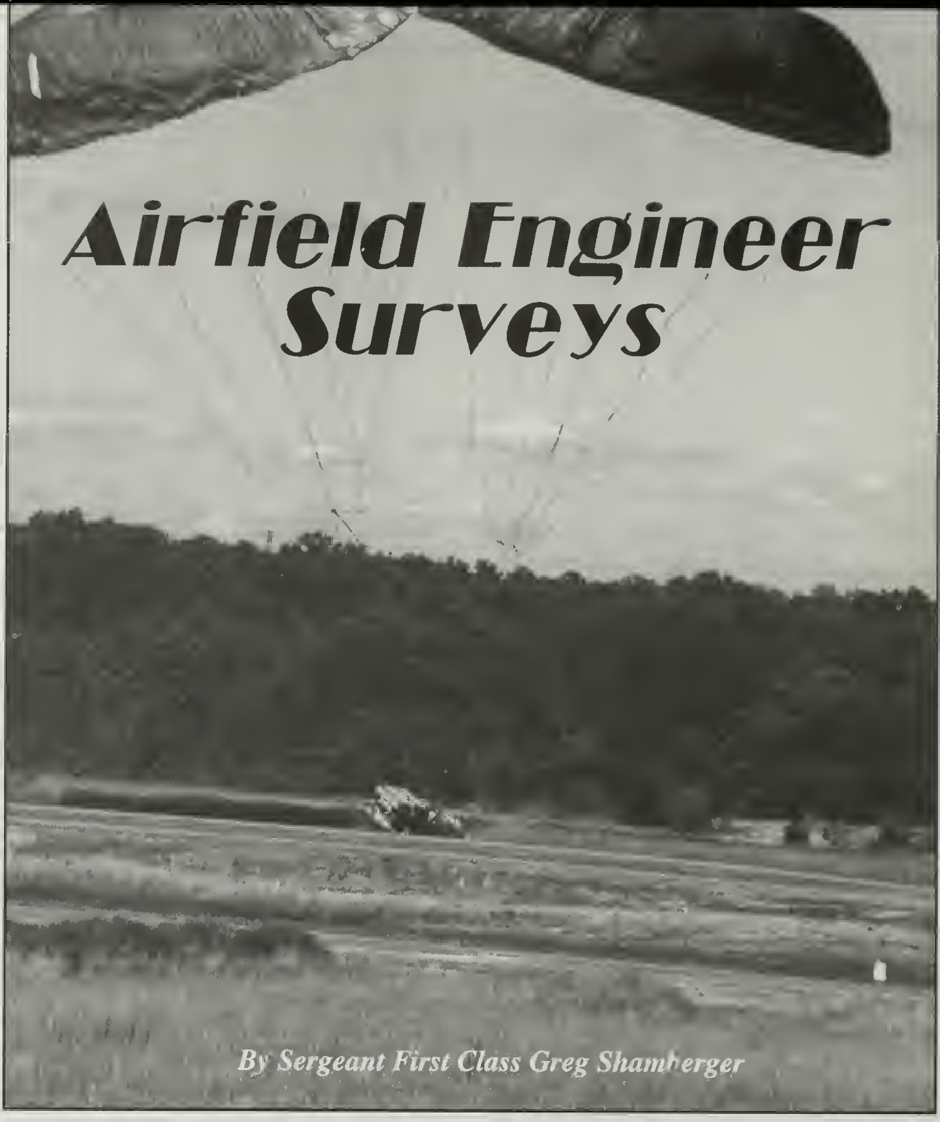
Airfield Engineer Surveys



By Sergeant First Class Greg Shamberger

One of the missions of U.S. Army topographic surveyors is to perform airfield surveys. In June 1999, topographic surveyors from the 175th Engineer Company (A) (T) at Fort Bragg, North Carolina, came to Fort Leonard Wood to update navigational aid (NAVAID) information for the Waynesville Regional Airport at Forney Army Airfield. The 175th is part of the topographic engineering community that provides precision surveying to support Army airfields, the U.S. Army Aeronautical Services Agency (USAASA), and the Federal Aviation Administration (FAA).

Airfields in the United States and those used by U.S. interests around the world must be surveyed every five years to remain certified. Army airfields require NAVAID engineering and Airport Obstruction Chart (AOC) surveys to comply with Army Regulation 95-2, *Airfield Traffic Control, Airfields, Flight Activities, and Navigational Aids*. The extensive field surveys provide aeronautical and other information to support a wide range of National Airspace System activities. The information acquired helps ensure that flights into and out of an airport are as safe as possible regardless of weather conditions.

An AOC is a map that depicts a plan view of an airfield. It shows a profile view of runways and associated landing approach slopes and a graphic display of possible obstructions in these areas. AOC surveys provide source information on the following:

- Runways and stop ways
- Navigational aids
- Federal Aviation Regulations Part 77 (FAR-77) obstructions
- Aircraft movement and apron areas
- Prominent airport buildings
- Selected roads and other traverse ways
- Cultural and natural features of landmark value
- Miscellaneous and special-request items

The positioning and orientation information for NAVAIDS is required to certify airfield instrument-landing approaches. AOC surveys establish geodetic control near the airport using permanent survey marks that are accurately connected to the National Spatial Reference System (NSRS). This control and the NSRS connection ensure accurate relativity between points surveyed on the airport and other surveyed points within the National Airspace System, including the Global Positioning System (GPS) navigation satellites.

In addition, AOC data is used to—

- Develop instrument approach and departure procedures.
- Determine maximum takeoff weights.
- Certify airports for certain types of operations.
- Update official aeronautical publications.
- Provide geodetic control for engineering projects related to runway/taxiway construction, NAVAID positioning, obstruction clearing, and other airport improvements.
- Assist with airport planning and land-use studies.
- Support activities such as aircraft accident investigations and special projects.

Topographic Surveyors

Topographic surveyors determine horizontal and vertical distances between objects, measure angles between lines, determine the direction of lines, and establish points of predetermined angular and linear measurements. They use these measurements to compute data for a final report, which is used for positioning by field artillery, air defense artillery, aviation, intelligence, and communications units. The report is also used for joint operations and to provide construction project control points.

The topographic surveyor, military occupational specialty 82D, is a low-density job skill that includes about 100 personnel. They are trained at the National Imagery and Mapping College, Defense Mapping School, at Fort Belvoir, Virginia. The courses of training are basic and advanced geodetic surveying. The curriculum includes instruction in surveying mathematics, advanced GPS equipment, computerized and mechanical surveying instruments, computer-aided drafting, and field-surveying procedures.

The Army has two other surveying disciplines—technical engineer and field artillery surveyor. The jobs have similarities but each is specialized to support different missions. Technical engineer supervisors/specialists provide drafting, surveying, and materials testing support. Field artillery surveyors provide a common grid to the required accuracy to permit delivery of effective fire to neutralize or destroy enemy targets.

These two job skills are concerned with operating over a flat plane with changing elevation but normally discount the curvature of the earth. Topographic surveyors, also known as geodetic surveyors, take into account the size and shape of the earth. Since the stations in geodetic surveys are routinely spaced over extended distances of 25 kilometers or more, more precise instruments and procedures are required than for other types of surveys. All observations are made on the actual curved surface of the earth and this curvature is corrected through computations. Differences between the types of surveys are based more on the equipment and techniques used than on surveying fundamentals.

Many topographic survey operations today are performed using the GPS. Topographic surveyors exploit the Navigation Satellite Timing and Ranging (NAVSTAR) GPS through the use of survey-quality GPS equipment. They determine accurate positional, velocity, and timing information. This is far different from using the precise, lightweight GPS receiver (PLGR). Engineer battalions and companies (topographic) in the U.S. Army have GPS receivers that can determine real-time and postprocessed relative positioning. These forms of positioning are accurate to approximately 1 centimeter, as compared to several meters with a PLGR.

Scope of Work

After receiving a survey project directive, mission planning and execution break into the following basic categories:

- Identify and verify the usefulness of existing survey control monuments in and around the airfield. These monuments are permanently established points with known horizontal and vertical components.
- Establish the network of known points that will be used to observe data needed for the project.
- Perform necessary observations.
- Compute, check, and produce required reports and charts.

Identify Control Monuments

Several levels of quality of survey control monuments are available for every project. Locating a starting point that meets required specifications is fundamental to the success of the survey. Often, pre-established points are widely separated and established on different datums. (A *datum* is defined as a reference surface consisting of different measurable quantities, such as the latitude and longitude of an initial point, and the azimuth line from this point.) Together they form a basis for computing the horizontal component of a survey control marker in which the curvature of the earth is considered. The vertical component is measured on a separate datum and is often referred to as *elevation*, which is a level surface that is usually referenced to mean sea level.

The requirement for airfield surveys in the United States is that the starting control points be part of either the World Geodetic System 1984 (WGS 84) or the North American Datum 1983 (NAD 83) for the horizontal position and the North American Vertical Datum of 1988 (NAVD 88) for the elevation.

As a historical reference, in 1927 a horizontal national network of survey markers was established using a

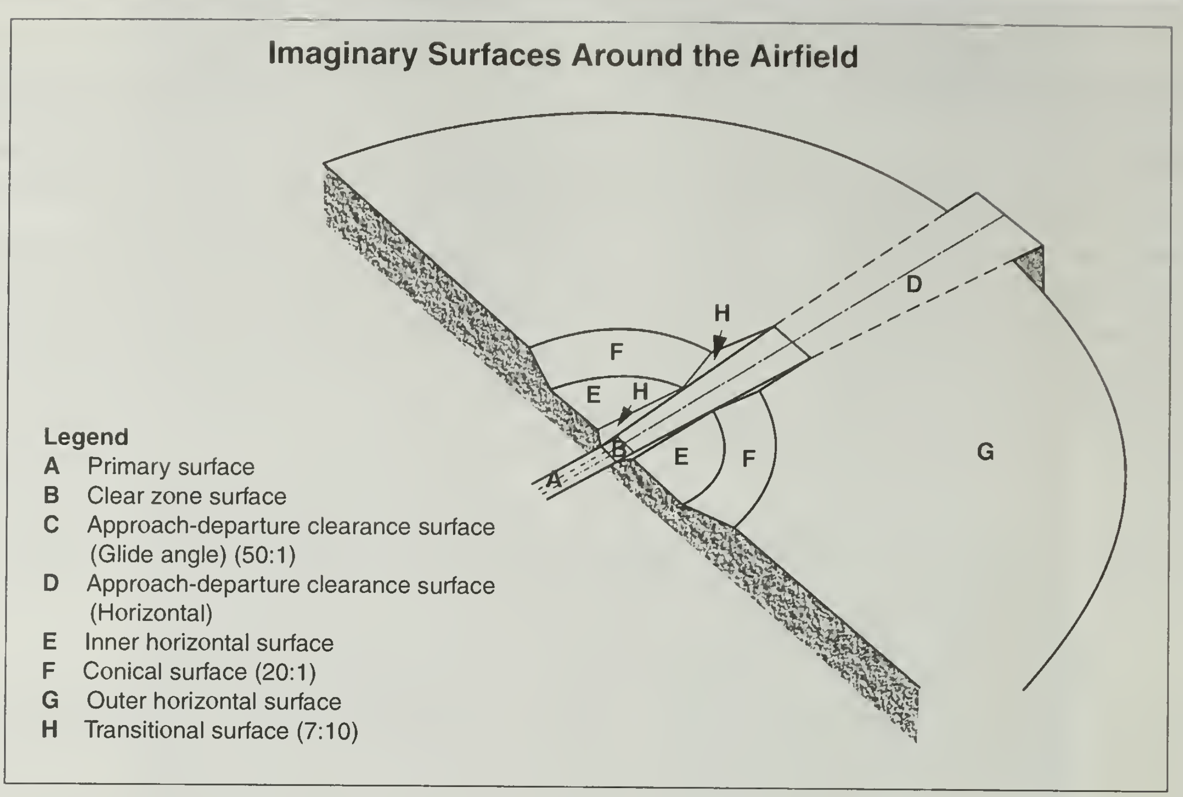

Imaginary Surfaces Around the Airfield
A
B
C
D
E
F
G
H
Legend
A Primary surface
B Clear zone surface
C Approach-departure clearance surface (Glide angle) (50:1)
D Approach-departure clearance surface (Horizontal)
E Inner horizontal surface
F Conical surface (20:1)
G Outer horizontal surface
H Transitional surface (7:10)

Figure 1

triangulation measurement system. This system, known as the North American Datum of 1927, is comprised of joined or overlapping triangles of angular observations supported by occasional distance measurements and astronomic observations. In 1929, the National Geodetic Vertical Datum was developed. The two systems were established with the use of mechanical transits to measure angles, spirit leveling to determine elevations, and linked chains to measure distance.

The process of changing to a more modern system is ongoing. With the evolution of equipment and techniques and the advent of GPS, more observations and refinements continue to be made. And newer, more precise reference datums (NAD 83 and NAVD 88) have been established. The problem is that both databases still exist, and an unaware user may use the wrong one. Operational awareness is key. The difference between the 1920s system and the modern system is many tens of meters in horizontal position.

While recognizing that different coordinate systems exist, keep in mind that operating with mixed reference datums is hazardous to navigation of any type—but especially to aviation. For example, when flying under low-visibility conditions and using instruments to land, missing the designated touchdown point on the runway by 100 meters to either side can be catastrophic. For these reasons and others, the NSRS was developed to provide the common frame of reference for air navigation.

Establish a Survey Network

Designing a network of control points in a project area establishes primary and secondary airfield control points, points needed to mark project specifications (such as the end of the runway), or points that are convenient for further observations. The network usually is developed using GPS equipment and procedures for horizontal positions. A GPS network is a designed geometric structure. The structure is as balanced as possible and contains redundant measurements to ensure that the overall geometric strength, and the individual points within it, have the highest degree of accuracy. The traverse method may be used, but it requires a line of sight between adjacent stations, whereas using a GPS only requires a clear view of the sky. Once the horizontal component is determined, elevations are established using geodetic leveling methods. Geodetic leveling is a measurement system comprised of elevation differences between nearby rods.

Perform Observations

The AOC requires that obstructions to navigation be identified. The criteria for determining if an object is an obstruction to air navigation is defined by the FAA. Each runway on an airport has three-dimensional imaginary surfaces surrounding it (see Figure 1). Each surface has a predetermined slope and/or difference in elevation associated with it when compared to the elevation of the runway. An obstruction is any object that exceeds this elevation.

The GPS is not the only instrument used to meet the horizontal position requirements for an airfield survey. Generally speaking, the GPS is used for points that can be occupied with equipment and personnel, and obstructions to navigation do not usually fit into this category. More

Photo by SGT King, 175th En Co

A soldier collects obstruction data for the airfield survey.

conventional equipment and procedures are used to identify obstructions.

The method of determining the position of a point that cannot be occupied is *intersection*, specifically a two-point intersection. This process determines the coordinate of a point by trigonometry. By using basic triangle mathematics, the length of one side of a triangle and two interior angles (A-B) can be measured, and the other variables can be solved (see Figure 2). Applying this to surveying, two known points are used to form the base of the triangle. The distance and azimuth between them is measured or computed. Then interior angles are measured and the results of the triangle computation are applied to an X, Y, and Z grid system to get a difference to the north or south and a difference to the east or west from each of the known points in the triangle. The difference in elevation of the unknown point is determined using right-triangle geometry.

Complete the Project

As a project progresses, the data collected is reduced and compiled for final reports. Several aspects of the airfield are drafted into a digital product using computed-aided drafting. The reports are a list of key points in and around the airfield. They include the airport reference point used in the flight information publication chart, the length and azimuth of the runways, the locations of important instrument-landing equipment, and an overall compilation of coordinates of obstructions within several miles. The AOC and a chart of runway markings are filed with the reports. After the reports and charts are completed, they are submitted to the USAASA for review. When approved, they are sent to the FAA, where the data is used to help determine flight safety procedures for the airfield.

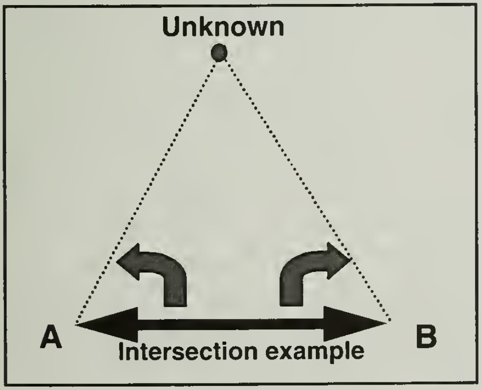


Figure 2

Other Topographic Missions

The topographic survey mission is not limited to airfield surveys. Topographic surveyors also support field artillery, air defense artillery, intelligence, and communications units, as well as units involved in joint operations and construction project control points. For example, topographic survey support is required for Multiple-Launch Rocket Systems (MLRS) field artillery units, corps general-support units, and other nondivisional assets in the corps area according to FM 6-2, *Tactics, Techniques, and Procedures for Field Artillery Surveys.* In addition, the National Imagery and Mapping Agency's Geodetic Survey Division maintains U.S. Army topographic surveyors as part of its force structure. Intelligence and signal units require positioning information for remote-operated vehicles, remote sensing and imaging systems, and antenna systems geo-location and direction.

The Army topographic survey mission is diverse, challenging, and rewarding. It continues to evolve with advances in geospatial technology. If it's precise geolocation you need, contact your corps or theater engineer office for assistance.

SFC Greg Shamberger is the senior training developer and writer for topographic surveying for the U.S. Army Maneuver Support Center and the Engineer School.

Detector Training:
It's More Than Lecture and Familiarization

By Dr. Gregory L. Bier and Randy Richards

Many publications over the past several years have related the significance of the global land-mine problem. And senior officers have articulated the impact these mines will have on current and future military operations. With the proliferation of antipersonnel mines with a low metal content, the problem becomes one of real importance—and danger—to untrained combat engineers.

The Countermine Modernization Strategy[1] rates the materiel solution to this dilemma as *RED* for near-term, hand-held detection. Even over the midterm, the rating only improves to *AMBER* with the fielding of the Hand-Held Standoff Mine-Detection System—a combination metal detector and ground-penetrating radar sensor. The implication is that only training will improve soldiers' ability to detect mines. This article reviews the current state of combat engineer metal-detector training and tactics, techniques, and procedures (TTPs) as compared to the abilities and TTPs of minefield-tested, real-world deminers with practical and life-threatening experience in minefields.

A soldier demonstrates the AN/PSS-12 Mine Detector.

Land-Mine Problem

The U.S. Department of State estimates that 60-70 million land mines are deployed in approximately 70 countries around the world.[2] Therefore, General Grey (U.S. Marine Corps, Retired) very accurately stated that land mines pose a significant threat to U.S. forces whether they are engaged in war, peacekeeping operations, or humanitarian missions. We saw firsthand the impact of Iraqi-emplaced land mines during Operation Desert Storm and land mines across the Bosnian theater of operations, in Somalia, and during relief operations following Hurricane Mitch in Honduras and Nicaragua. Land mines will continue to impact combat engineers whenever and wherever they are deployed. Therefore, our soldiers must be *skilled* operators of fielded mine-detection equipment. It is not sufficient or reasonable to rely on the period of familiarization provided to soldiers during their advanced individual training. To confidently operate a detector and be able to detect low-metal contact land mines, units must ensure that soldiers receive realistic, hands-on, in-theater training.[3]

Current Training

Engineer after-action reports prepared after Operation Desert Storm indicate that the "hand-held detector was used as a last resort, proving unreliable..." These reports relate that only 50 percent of the operational detectors "could actually detect the minute amount of metal found in plastic mines used by Iraq. These factors resulted in poorly trained soldiers who lacked confidence."[4] Since then, combat training centers routinely relate the difficulties units have in performing route-sweep and area-clearance operations. While units may depend on "schoolhouse" training, it does not provide the field with competent and confident metal-detector operators. Units must provide additional training.

Current Engineer School detector training consists of a four-hour lecture to a 150-person class on the Schiebel AN/PSS-12 Hand-Held Metallic Mine Detector. During the class, the student-to-detector ratio is one to five. Each student is then evaluated during a 10-minute hands-on exercise. The

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A soldier prepares to remove the AN/PSS-12 from its carrying case.

operational requirements document for the mine detector sets the probability of detection (PD) at greater than 0.92 at an advance rate of approximately 18 seconds per square meter.

Experts vs. Soldiers

Dr. James J. Staszewski, Carnegie Mellon Research Institute, did an extensive study on land-mine-detection skills.[5] In the study, Staszewski compared the skills of mine-detection experts who had extensive minefield experience with the skills of typical soldiers using an AN/PSS-12. The soldiers achieved a PD of 0.71, which is well below the Army requirement. The experts achieved a PD of 0.93. The reason for this dramatic difference is not the equipment or materiel—it is the *training and experience.*

Practical TTPs and Lessons Learned

Becoming a proficient mine-detector operator requires a lot of practice. The following procedures will help soldiers learn the skills they need:

Well-trained mine-detector operators have the ability to paint a picture in their minds based on feedback from the detector. This spatial diagram depicts the size and shape of the target. Based on their experience in detecting various mines they expect to encounter, trained operators can then say with confidence *what* they have detected.

It is important that operators be trained on specific mines, not just pieces of metal. If trained on generic mines, they cannot memorize detector signals and shapes associated with specific targets. In ideal training conditions, operators place the real mine—freed from explosives—in their calibration or training lane. The lane should replicate soil conditions of the area they expect to sweep, especially when operating in laterite or conductive soil. The mines must be placed in the ground as they are expected to be found.

An operator conducts a sweep to determine whether a target is present in the area directly to his front. He does this by sweeping the detector head back and forth at an acceptably slow rate while listening to detector feedback. At the same time, the operator visually inspects the area for indicators of mines. If the detector provides no evidence of a target, the operator advances the diameter of the search head and repeats the sweep pattern. When detector feedback provides a target alert, the routine is changed. Then the goal is to inspect the target.

Target inspection should result in identifying the shape and metallic strength of the object detected. One such method is to "trace" the target, which means that the boundaries of the alerting signal are traced with the detector in a series of patterns (using either a common "box" or "X" pattern). This provides operators with a picture of the target's shape and metallic strength. For added details, experts often tilt the search head from 30 to 90 degrees to focus the feedback produced. This mental picture is then compared to target shapes and strengths found in the calibration lanes.

While soldiers often simply search for metal, experts use this tracing method to paint an adequate picture to identify the mine type. This results in such comments from soldiers as—

- "Big ring-off...longer than it is wide...rectangular...kind of like a PMD6."
- "That looks like an M14."
- "That's too long and skinny...probably a piece of barbwire." [6]

Without practice at memorizing targets in a calibration lane, soldiers have no mental picture of what they are looking for. They merely act as metal detectors, not mine detectors. Staszewski correctly concludes that "Experts have high-quality, well-integrated, and easily accessible 'standard' patterns against which perceptual input can be compared to properly categorize it."[7]

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"To confidently operate a detector and be able to detect low-metal contact land mines, units must ensure that soldiers receive realistic, hands-on, in-theater training."

Skills for Experts

Mine detectors must be calibrated often—sometimes as often as every 3 meters. Many experts simplify this task by conducting the initial calibration on the mine as described above. Then they slide a metal mason's trowel (used for uncovering a target) down the telescopic handle of the detector until they hear an alert signal. They place a colored cable clamp at this point. To check the calibration during operation, they take out the metal trowel and slide it down the telescopic handle again to ensure that the detector gives an alert signal when the trowel reaches the colored cable clamp. If an alert signal is heard either before or after that point, the detector must be recalibrated.

This calibration technique also is useful when pinpointing the center of large metallic mines. For example, when a large target is detected, the sensitivity of the detector can be turned down to locate the target's exact center of mass. The procedure is also effective when an unusually large target area is detected. This realistic scenario may occur when a large metallic antitank mine is surrounded or shadowed by smaller antipersonnel mines. By decreasing the mine detector's sensitivity and sweeping the search head across the target area, the operator can locate the smaller centers of mass of each target. Once this is done, the detector is reset.

Detector sensitivity may be enhanced by placing the search head directly on the ground, rather than maintaining a 5-centimeter distance above the soil. Experts have demonstrated this technique in numerous theaters. Additionally, operators should not let vegetation dictate the search pattern. The search head should not be raised to sweep over a clump of long grass. If vegetation looks out of place or suspicious, don't avoid it; check it out.

The AN/PSS-12 can detect low-metallic lines buried as deep as 6 inches.

The headphone cables often become entangled with other personal gear, which may distract the operator. Additionally, dangling cables may prohibit movement of the operator's arms. Using an external speaker eliminates one of these cables. The speaker also allows the safety observer or supervisor to listen to the tones as the detector operator progresses.

Experts work slowly. The operator's manual suggests a sweep rate of 1 meter per second,[9] which correlates to a rate of 16 seconds per square meter. However, operators have found that if they work at a slower rate—in a cautious, yet mission-sensible manner—the probability of detection increases. In the study conducted by Staszewski, soldiers tended to sweep at a rate of 20.5 seconds per square meter, while experts operated at a rate between 33.3 and 54.6 seconds per square meter.

Be aware of environmentally imposed constraints on the search head. The Canadian army reported a loss of sensitivity of the detector when the search head became moist or wet.[10] This is potentially very dangerous if the operator is unaware of the limitation. The Canadians also determined that the search head's detection depth decreased from 16-17 centimeters to 11-12 centimeters when wet. The decrease in sensitivity can be eliminated by recalibrating the detector or drying the search head. In damp conditions, Canadian experts recommend adjusting the detector's sensitivity so it produces a constant low "chatter" instead of the usual ticking.

Commercial Munitions Systems International (CMSI) (a contractor) used the AN/PSS-12 Mine Detector for 38,000 hours while demining areas after the Gulf War.[11] CMSI personnel determined that the mine detector is sensitive to extreme heat.[12] They noted that the detector began to lose sensitivity at 110 degrees ground temperature. The loss of sensitivity could be compensated for through recalibration or by rotating detectors in and out of operation every 30 minutes. Operator complacency tends to increase during extreme heat. Therefore, it may be safer to delay mine detection until a cooler time of the day if personnel are concentrating on the heat rather than the clearing operation.

When operating in extremely cold conditions, battery life may be extended by carrying the electronics unit under the operator's outer garments to keep the battery warm.[13] However, don't trust your life to rechargeable batteries! CMSI personnel in Kuwait found that recharged batteries lost power suddenly. Once batteries reached a certain drop-off point, the detector quit without warning. There was no low-battery light signal from the detector during the period just before shut-off. For this reason, CMSI used only BA-30 or D-cell alkaline batteries.[14]

Use teams for mine detection. Contractors such as CMSI and other demining organizations use two-person teams, which train and operate together and are not split up. Since these teams operate in stressful environments, it is important that they build a strong and trusting working relationship. The teams consist of a mine-detector operator and a safety observer. FM 20-32, *Mine/Countermine Operations*, refers to the safety team member as a "prober/marker."[15] However, this second person should have responsibilities beyond those mentioned in the field manual. He also should observe the minesweeper, look for signs of fatigue, ensure that procedures are followed, maintain contact with personnel outside the mined area, and mark the cleared lane. The safety observer must be close enough to see and hear everything.

During routine maintenance, ensure that battery springs have not lost their natural tension. With extensive use, springs often loosen, which prevents batteries from maintaining good contact with the electronics unit and the battery cover.

Building Competency

Combat engineer mine-detector operators face tremendous adversities in land-mine-infested theaters of operation. In the field of mine detection, there is no short-term answer for providing a better materiel solution than the AN/PSS-12. Therefore, Army unit leaders must train operators to be proficient with this detector. To improve their capability, operators must be confident in their work, and their leaders must have confidence in them. Remember to paint a mental picture of the mine and calibrate the detector accurately and often. Slow down the rate of sweep, and put the search head on the ground. Understand the effects of moisture and temperature on the equipment and the operator. And, finally, build a competent detection team. Your life and the lives of your fellow soldiers may depend on it!

Questions or comments may be e-mailed to richardsr@wood.army.mil.

Dr. Bier, a former combat engineer officer, served as technical director of the U.S. Army Engineer School's Countermine Training Support Center and the Department of Defense Humanitarian Demining Training Center. Dr. Bier is currently an instructor at Stephens College, Columbia, Missouri.

Mr. Richards is a training specialist with expertise in threat mine identification. He instructs both humanitarian demining operations (HDO) courses and predeployment mobile training teams. Mr. Richards attended the HDO Course in Paris, France; the Unit Search Adviser (ROW), Royal School of Military Engineering, United Kingdom; the Sapper Course; and the Combat Engineering Skill Level 1-4 course. He has more than 21 years of active duty military service as a combat engineer.

Endnotes

[1] *Countermine Modernization Strategy*, U.S. Army Engineer School, 1996, page 27.

[2] *Hidden Killers: The Global Landmine Crisis.* U.S. Department of State, Bureau of Political-Military Affairs, September 1998, page 1.

[3] "Operating a Mine Detector: Proficiency Through Practice," *Engineer*, August 1994, page 22.

[4] *Engineer After-Action Report (Final Draft), Operations Desert Shield and Desert Storm.* U.S. Army Engineer School, Directorate of Evaluation and Standardization, May 1993, page 2.

[5] *Information Processing Analysis of Human Land Mine Detection Skill*, James J. Staszewski, Carnegie Mellon Research Institute and Department of Psychology, Carnegie Mellon University, 1999.

[6] Staszewski.

[7] Staszewski.

[8] Operator Manual, AN-19/2 Mine Detecting Set, Department of the Army.

[9] Operator Manual, AN-19/2 Mine Detecting Set, Department of the Army.

[10] *National Defense Demining Action Center Newsletter*, Vol. 01, No. 02, April 1996.

[11] "Lessons Learned: Kuwaiti Minefield Clearing Operations," CPT Lawrence M. Chirio, *Engineer*, August 1994, page 25.

[12] Chirio, page 26.

[13] Operator Manual, AN-19/2 Mine Detecting Set, Department of the Army.

[14] Chirio, page 26.

[15] *Mine/Countermine Operations*, FM 20-32, Department of the Army, May 1998, page 11-9.

USAES

Graduate Degree Programs Expand Your Options

By Captain Marc Hoffmeister

The U.S. Army Engineer School, in conjunction with the University of Missouri-Rolla (UMR) and the University of Missouri-St. Louis (UMSL), continues to lead the way in providing outstanding opportunities for professional education. Since November 1994, nearly 400 officers have successfully earned master of science degrees through the Engineer School's Cooperative Degree Program.

The University of Missouri-Rolla and the University of Missouri-St. Louis grant graduate credits for the 18-week Engineer Captains Career Course (ECCC), Phase I. Active Component officers who qualify for admission to the program remain 16 weeks after ECCC, Phase I, to complete the program. Following graduation, the officers attend Phase II of the ECCC at Fort Leavenworth, Kansas. To be eligible, officers must meet UMR/UMSL enrollment requirements. Reserve Component officers may attend if their chain of command authorizes an extension.

Admission Requirements

To be eligible to apply, officers must hold a bachelor's degree in engineering or hard science from a college of good standing. They must have a cumulative grade point average of 3.0 for their undergraduate study to achieve regular admission status. Officers with an undergraduate grade point average between 2.75 and 3.0 are accepted but are in a "special status" similar to academic probation. A graduate record examination taken within the past five years is required. Officers have until the completion of ECCC, Phase I, to take the examination, which is given monthly at the Fort Leonard Wood Education Center. No minimum score is required.

After officers are accepted by UMR, the Engineer Branch extends them at Fort Leonard Wood in a permissive status—not TDY—to complete the master of science program of their choice. The cost for the programs varies but never exceeds $6,000; degrees of this caliber normally cost more than $10,000. Tuition assistance pays approximately 75 percent of the cost per credit for courses taken during the ECCC. Tuition assistance is not available for classes taken during the two 8-week sessions or the 16-week semesters. An officer who has applied for the Montgomery GI Bill upon entering active duty can use it to pay for the program. Student loans may also be available through local banks, credit unions, and UMR.

Degree Programs

While the word is out about the UMR engineering management program, it is not as well known that officers may also pursue a degree in environmental engineering or civil engineering (CvEng). In September, the Engineer School implemented a new program with UMSL that provides students without an engineering background the opportunity to earn a master's degree in public policy administration.

Engineering Management (EngMg)

Officers accepted into the engineering management program begin classes the first or second week of ECCC. ECCC instruction earns them 8 credits for CvEng 345, *Engineering Construction Contract Specifications*; EngMg 313, *Human Relations in Technical Management*; EngMg 314, *Management for Engineers*; and CE 380, *Water Resources and Wastewater Engineering* or CE 442, *Construction Administration, Planning and Control*. Officers also receive an additional 4 credits (1 credit for each of these courses) for instruction by a UMR professor.

Upon graduation from ECCC, officers will have earned 12 credits. Then they attend UMR full time for two 8-week sessions. Each session consists of three courses totaling 9 credits. Classes taken during ECCC and the 8-week sessions are taught at the Maneuver Support Center at Fort Leonard Wood, with occasional visits to the UMR campus.

The point of contact for the engineering management program is Rose Lynch at (573) 329-2707 or e-mail at *rlynch@umr.edu*. Additional information about the engineering management program is at *http://www.wood.army.mil/OTD/sectn13.htm*.

Environmental Engineering

An environmental engineering degree program is available for prospective candidates during the second and fourth Engineer Captains Career Course of the fiscal year. Interested officers should coordinate with their assignment officer to attend either of these ECCCs.

Admission criteria for the environmental program are similar to those for the engineering management program. Officers can choose from two degree options depending on their undergraduate degree: master of science in environmental engineering or master of science in civil engineering (with environmental emphasis). The following prerequisites apply to nonengineers: two semesters of chemistry; three semesters of calculus; and one semester of fluid mechanics, statistics, engineering economics, mechanics of materials, and hydraulics.

Officers accepted into the environmental engineering program begin classes the second or third week of ECCC. They take two 3-credit courses, which are taught one night per week at the UMR campus. For ECCC instruction, officers are granted partial credit for CvEng 345, *Construction Methods;* CvEng 300, *Special Topics*; and EngMg 308, *Economic Decision Analysis*. These classes are taught in the evening at the Maneuver Support Center at Fort Leonard Wood. By the completion of ECCC, Phase I, and the associated classes, officers will have earned 18 credits. After ECCC, Phase I, officers attend classes full time on the UMR campus for a 16-week semester.

The point of contact for the environmental engineering program is Dr. Craig Adams at *adams@umr.edu* or (573) 341-4041.

Civil Engineering

The civil engineering degree program is also available during the second and fourth Engineer Captains Career Course of the fiscal year. Interested officers should coordinate with their assignment officer to attend one of these ECCCs. The first offering of the civil engineering degree program is during ECCC 2-00 and aligns with the Fall 2000 semester at UMR. Officers who successfully complete the program will be awarded a master of science degree in civil engineering in December 2000.

For this program, students obtain 18 credits at Fort Leonard Wood and, immediately following ECCC, must complete 15 credits at the UMR campus. Officers accepted into the civil engineering program begin classes the second or third week of ECCC. They take two 3-credit courses, which are taught one night per week at the UMR campus: CvEng 400, *Special Problems* and CvEng 3XX, *(department offering)*. In addition, for ECCC instruction officers are granted partial credit for CvEng 345, *Construction Methods*, and CvEng 442, *Construction Control*. Students also select two of the following partial-credit engineering management classes: EngMg 308, *Economic Decision Analysis*; EngMg 314, *Management for Engineers*; or EngMg 361, *Project Management*. These classes are taught in the evening at the Maneuver Support Center at Fort Leonard Wood. By the completion of ECCC, Phase I, and the associated classes, officers will have earned 18 credits. Then they attend classes full time at the UMR campus for a 16-week semester.

The point of contact for the civil engineering program is Dr. Paul Munger at *munger@novell.civil.umr.edu* or (573) 341-4693. The UMR Civil Engineering Department homepage, at *http://www.umr.edu/~civil/fortwood/*, provides additional information about both the environmental and civil engineering programs.

Public Policy Administration

The Engineer School and the University of Missouri-St. Louis have recently finalized a Cooperative Degree Program offering a master's degree in public policy administration (MPPA) to ECCC students. While some graduate degree programs emphasize either public administration *or* public policy, the UMSL degree program will combine the two. The MPPA program will prepare Army officers for enhanced career opportunities in both line and staff functions.

The MPPA program includes 40 nonthesis credits—28 in the core curriculum and 12 as shared-credit classes, which are the foundation of the UMR engineering management program. This program provides opportunities for officers without an engineering or hard science bachelor's degree. The program relies heavily on the UMR engineering management program for all elective credits.

The National Association of Schools of Public Affairs and Administration requires that students be enrolled in the program a minimum of one year to meet graduate criteria. The program will accomplish this by allowing students to complete a mandatory exit project during ECCC, Phase II, and submit the project from their follow-on station. Then the program fits in the Engineer School Cooperative Degree Program time line of 34 weeks at Fort Leonard Wood. The date for the first program is ECCC 1-00 (15 November 1999 - 5 April 2000). The program will align with the first class of each fiscal year.

Accept the Challenge

With the heightened intensity of the Army's operational tempo, earning an advanced degree has become an ever-increasing challenge. The opportunities provided by Fort Leonard Wood, the University of Missouri-Rolla, and the University of Missouri-St. Louis make this career-enhancing step possible. If you meet the admission criteria and are ready for the challenge, enroll in the program. There will never be a more ideal opportunity to expand professional competence or to earn a professional qualification from such outstanding institutions.

For more information, contact the Engineer School's Graduate Degree Program Coordinator, Captain Marc Hoffmeister, at (573) 596-0131, extension 3-5641, or by e-mail at *hoffmeim@wood.army.mil.*

Captain Hoffmeister is a small-group instructor for the Engineer Captains Career Course. He holds a master's degree in engineering management from the University of Missouri-Rolla and is a registered professional engineer in Missouri.

Readiness: Engineers Making It Happen

By Major Michael C. Wehr

Engineers face many challenges to ensure that a mechanized division can successfully execute its wartime mission. Having the right materials and equipment on hand for deployment is a challenge the 3rd Infantry Division (3ID) Engineer Brigade at Fort Stewart, Georgia, has addressed with measurable success.

This article describes the material and equipment that the 3ID *anticipated, procured*, and ultimately *configured* to mark lanes through breached minefields, ensure that Class IV materials are available for barriers and overhead cover, and mark unexploded ordnance (UXO) as it is encountered.

Marking Breached Lanes

Anticipated

FM 90-13, *Combined-Arms River Crossing,* Appendix F, describes planning considerations for large-scale breaching operations as follows: "*A large-scale breach is defined as a breaching operation conducted by brigades and divisions to create a penetration through a well-prepared defense and to pass follow-on brigades or divisions.*"

Experiences in Southwest Asia showed a significant shortfall in equipment for lane marking breached minefields in anticipated division-level breaching operations. The mission of the 3ID demanded an increase in the quantity and quality of lane-marking equipment. The previous equipment was not an effective system for large-scale breaching. Also, the equipment on hand represented only one-third of the requirements for division-level breaching operations. The 3ID did not expect the required equipment to be available in theater. There was no assumption that depot level supply could provide the equipment fast enough once the 3ID arrived in theater.

To identify the necessary materials, the Engineer Brigade followed the guidance of FM 90-13-1, *Combined-Arms Breaching Operations*, Appendix E. Figure 1, page 53, shows the three standard levels of marking for breached lanes through minefields: initial, intermediate, and full. Each level provides an increase in lane signature and capability. Lane requirements change as a breaching operation matures from the initial breach to the forward passage of large combat forces.

Initial lane marking consists of just enough marking to establish a one-way, single lane of traffic through a breached minefield. According to FM 90-13-1, initial lane-marking requirements are driven by the nature of the fight through an obstacle. Marking must be rapid and provides only the bare minimum signature needed to pass small units (company teams and platoons) that make up the initial assault force through the obstacle.

Intermediate lane marking consists of enough materials for a single lane of traffic. According to FM 90-13-1, the lane signature must be more extensive and more visible than initial lane marking. Lane marking must guide larger forces over a greater distance to the lane's entrance without interruption.

Full lane marking makes the final improvement on the breach lane by providing enough materials for two lanes of traffic. Depending on the situation, the two lanes can accommodate traffic flowing from two directions or two lanes of traffic from one direction. According to FM 90-13-1, two-way traffic becomes a priority for the simultaneous forward passage of combat units as well as return traffic (such as ambulances and empty supply vehicles) necessary to sustain the force.

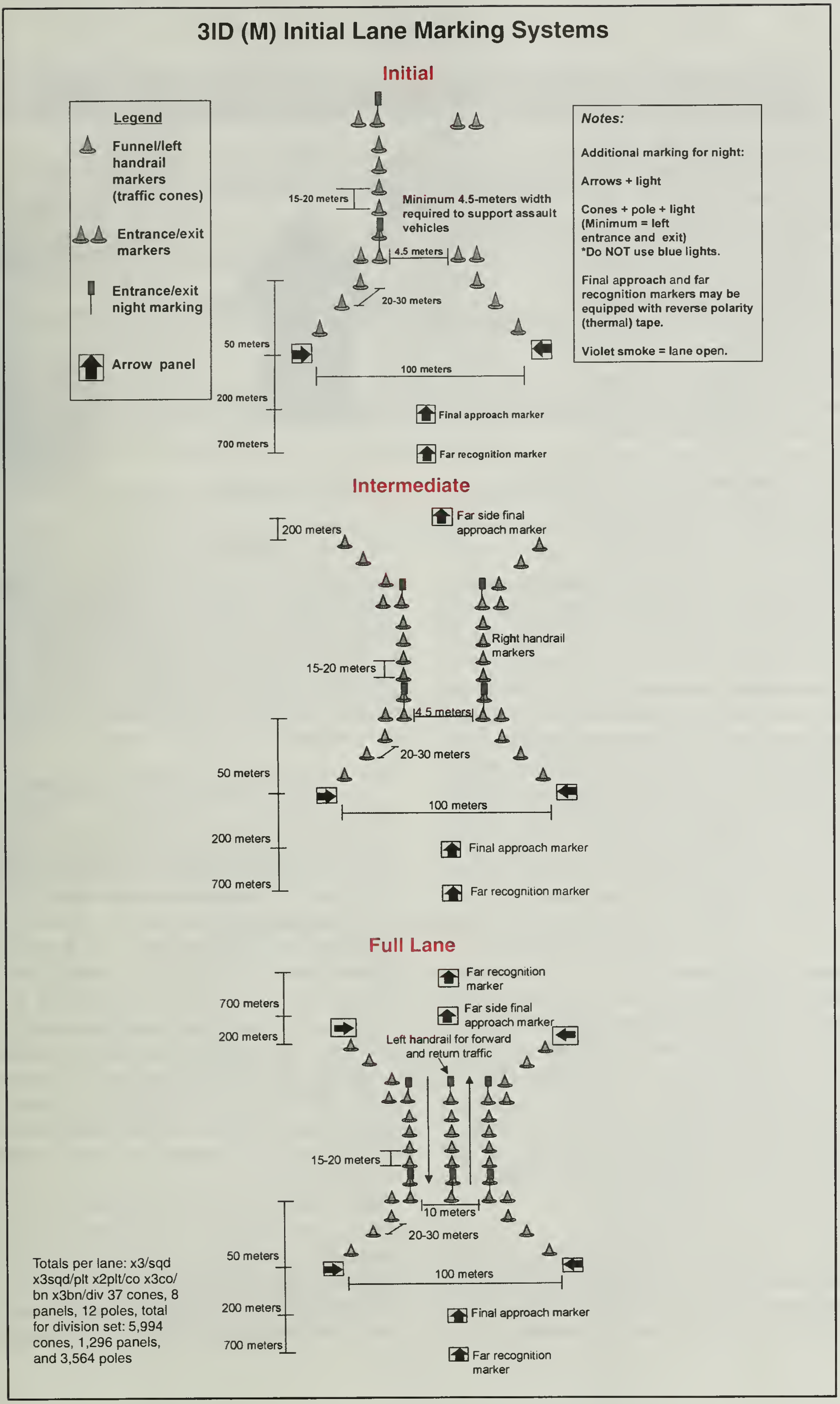
Procured

The 3ID invested $148,400 in a contingency stock of breached-lane marking materials (see Table 1). The decision for this expenditure was not reached overnight and was not the result of an alert in November 1998. The funds were

Table 1

Breached-Lane Marking Materials

Material	Quantity	Unit Price	Cost
Locally purchased panels	1,044	$14.00	$14,600
Cones, NSN 9905-00-527-4997	9,186	11.00	101,000
Poles, NSN 9905-01-068-8638	4,374	7.50	32,800
Total			$148,400



3ID (M) Initial Lane Marking Systems

Notes:

Additional marking for night:

Arrows + light

Cones + pole + light (Minimum = left entrance and exit)
*Do NOT use blue lights.

Final approach and far recognition markers may be equipped with reverse polarity (thermal) tape.

Violet smoke = lane open.

Totals per lane: x3/sqd x3sqd/plt x2plt/co x3co/bn x3bn/div 37 cones, 8 panels, 12 poles, total for division set: 5,994 cones, 1,296 panels, and 3,564 poles

Figure 1

dedicated after more than a year of planning, discussing, and convincing that large-scale breaching operations were likely. Evidence of this planning is in the 3ID's development of the "Penetration-Box" SOP. The decision to invest the money was the result of having a chain of command that was familiar with and supported the concept of large-scale breaching operations.

Appendix E of FM 90-13-1 focuses on a standard lane-marking pattern rather than on standardizing the marking device. Until the Army adopts a standard lane-marking device, commanders decide what hardware to use. (FM 90-13-1, Appendix E, Figure E-6, shows examples of several nonstandard lane-marking devices.) However, regardless of the type of device used, it must support the standard lane-marking pattern outlined in Appendix E. The 3ID supports this standard marking pattern and provides a solution for marking devices.

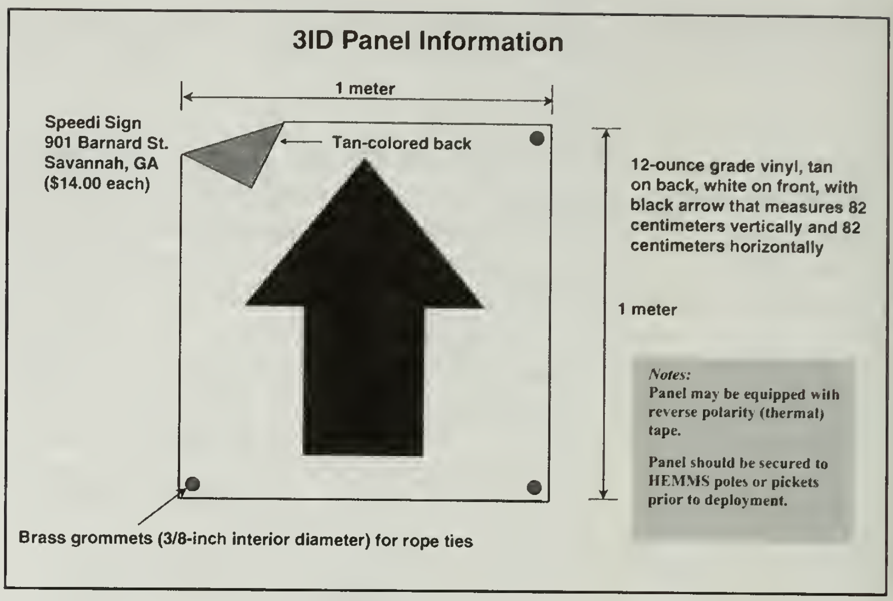

3ID Panel Information
1 meter
Speedi Sign
901 Barnard St.
Savannah, GA
($14.00 each)
Tan-colored back
12-ounce grade vinyl, tan on back, white on front, with black arrow that measures 82 centimeters vertically and 82 centimeters horizontally
1 meter
Notes:
Panel may be equipped with reverse polarity (thermal) tape.
Panel should be secured to HEMMS poles or pickets prior to deployment.
Brass grommets (3/8-inch interior diameter) for rope ties

Figure 2

NATO Standardized Agreement (STANAG) 2889 directs commanders to convert marking devices to NATO standard as early as possible if lanes are to be used by troops of other nations. NATO standard markers are shown in FM 90-13-1, Appendix E, Figure E-7. The standardized lane-marking pattern allows for quick conversion to the STANAG requirements (see FM 90-13-1, Appendix E, Figure E-8). The mission to convert intermediate or full lane-marking patterns to NATO standard is normally assigned to the corps-level engineer battalions working in the division rear area.

Procurement followed guidelines for obtaining materials that are readily available and already in use for training. Each sapper squad in the division received enough materials to emplace three complete breached-lane marking systems. A local vendor produced the panels according to specifications indicated in Figure 2. The cones are standard 28-inch orange traffic cones. The poles are from the M133 Hand-Emplaced Minefield Marking Set (HEMMS), which is described in an article on page 11. The M133 HEMMS is available through normal supply channels.

Configured

The initial assumption for deployment of the breached-lane marking system is that it will be transported by air. This may or may not be the case, but it is a starting point. Task force packages (for one sapper company of six squads) are a usable configuration and allow logistical flexibility. The Engineer Brigade configured nine air cargo pallets—one for each task force in the division or three per brigade combat team. Each pallet contains enough materials to mark 18 lanes of two-way traffic: 666 cones, 144 panels, and 396 poles. These pallets are currently configured and positioned in the 3ID's deployment facility at Hunter Army Airfield, Georgia.

Ensuring Class IV Availability

Anticipated

The availability of materials for force protection is a concern for commanders deploying to an undeveloped theater, as is the need to establish perimeter barriers and overhead cover. Some theaters have Class IV materials already in position, but others do not. FM 5-103, *Survivability,* gives details on planning and designing fighting and protective positions. The Class IV materials identified to support a division ready brigade focus on triple-standard concertina wire barriers and overhead cover for fighting positions. The manual addresses initial requirements for a deployed brigade combat team. The design required for force protection depends on various factors, such as weapon employment and effects and the time and construction materials available.

Procured

The 3rd Infantry Division invested $166,000 in barrier and overhead cover material to ensure some force protection regardless of the theater of conflict. Procurement followed the guides for obtaining materials commonly used for overhead cover (plywood, wood posts, and sandbags) and wire obstacles (concertina wire and pickets). Major components and

Table 2

Barrier and Overhead Cover Materials		
Material	**Quantity**	**Cost**
Concertina wire	3,000 rolls	$94,000
Barbwire	225 rolls	8,900
Long pickets	8,250 each	34,000
Short pickets	1,125 each	3,600
Sand bags	180 bundles of 100 each	7,500
Plywood (3/4" x 4' x 8')	150 sheets	5,000
Wood Posts (4" x 4" x 8')	750 each	13,000
Total		$166,000

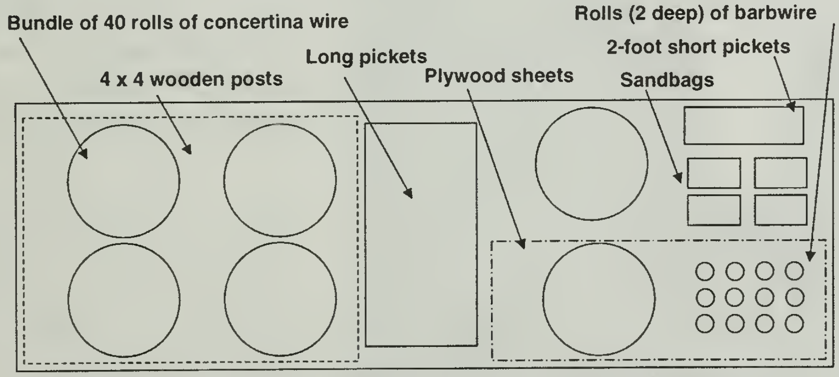
estimated costs of the Class IV materials are shown in Table 2.

These materials translate into initial requirements for 150 two-man fighting positions and approximately 50 triple-standard concertina obstacles 300 meters long. The initial start (not the final solution) of a fighting position consists of 1 sheet of plywood, 5 wood posts, and 100 sandbags. A 300-meter, triple-standard concertina obstacle consists of 60 rolls of concertina wire, 4 rolls of barbwire, 160 long pickets, and 12 short pickets.

Configured

Class IV materials currently are configured in depot packs and stored in a warehouse at Hunter Army Airfield, which provides security and protection from the elements. Due to space limitations, the configuration is in a bulk arrangement. However, the Engineer Brigade developed load plans to rapidly load them into movement containers if a decision is made to deploy with Class IV materials. The materials are divided into three equal packages—each configured into four MILVANs—to ensure that there are three usable task force sets. Each task force will receive the following Class IV materials, which equate to at least sixteen 300-meter triple-standard concertina obstacles and the start of 50 fighting positions: 1,000 rolls of concertina wire, 75 rolls of barbwire, 2,750 long pickets, 375 short pickets, 60 bundles of sand bags (100 each), 50 sheets of plywood, and 250 wood posts. Figure 3 shows the configuration for three of the four task force MILVANs. The configuration for the fourth MILVAN is shown in Figure 4, page 56.

Class IV load configuration in a 20-foot MILVAN (overhead cover for 12 positions and 4- x 300-meter obstacles of triple-standard concertina wire)

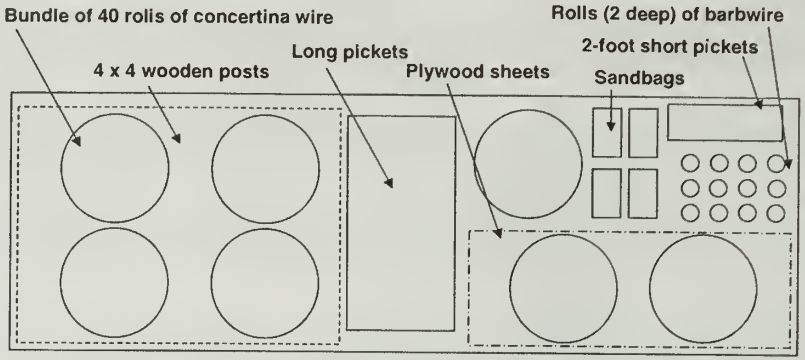


Twelve positions and 1.2 kilometers of triple-standard concertina wire equates to 240 rolls of concertina wire, 12 rolls of barbwire, 640 long pickets, 48 short pickets, 12 plywood sheets, 60 wood posts, and 12 bundles of sandbags (100 each).

Additional space allows for 6 rolls of barbwire, 40 long pickets, and 42 short pickets.

Figure 3

Class IV load configuration in a 20-foot MILVAN (overhead cover for 14 positions and 4- x 300-meter obstacles of triple-standard concertina wire)



Fourteen positions and 1.2 kilometers of triple-standard concertina wire equates to 240 rolls of concertina wire, 12 rolls of barbwire, 640 long pickets, 48 short pickets, 14 plywood sheets, 70 wood posts, and 14 bundles of sandbags (100 each).

Additional space allows for 40 rolls of concertina wire, 9 rolls of barbwire, 70 long pickets, 57 short pickets, and 10 bundles of sandbags (100 each).

Figure 4

Marking Unexploded Ordnance

UXO on the battlefield represents a significant hazard to ground forces. This is especially evident after an extended air campaign. The UXO challenge encountered during the Gulf War must be anticipated in future areas of conflict that require ground forces. The Engineer Brigade of 3ID is currently exploring possible solutions for a marking system that can be employed by soldiers in any type of vehicle who identify UXO on the battlefield. The current concept is to have a marking system that is employed similar to the way that vehicle "warning triangle" kits are employed. The an-ticipated pace of a mechanized division would preclude deliberate disposal of UXO. However, the initial marking of UXO should be an option for the commander and would greatly assist follow-on forces.

According to GTA 9-12-1, *Unexploded Ordnance (UXO) Procedures*, a simple marker is under evaluation. It consists of a plastic sign mounted on a light gauge 4-foot metal post (see Figure 5).

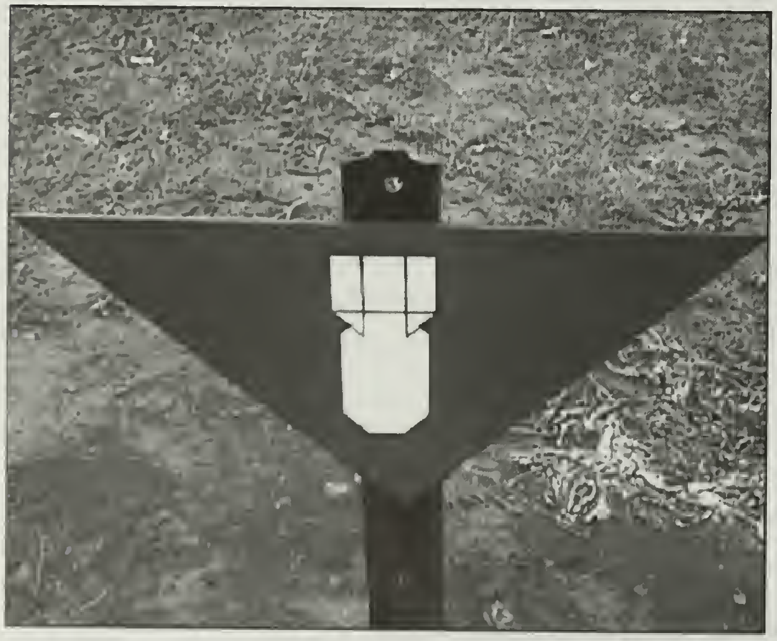


Figure 5

Conclusion

Any division today must be concerned about marking lanes through breached minefields, ensuring that sufficient Class IV materials are available, and marking UXO. This article describes the material and equipment that has been *anticipated*, *procured*, and to various degrees *configured* by the 3rd Infantry Division. The author hopes that this article provides an example for improving readiness that other engineer units can learn from and improve upon.

Major Wehr is the S3 of the 92nd Engineer Combat Battalion (Heavy), Fort Stewart, Georgia. He previously served as the Engineer Brigade S4, 3rd Infantry Division, at Fort Stewart, following attendance at the Command and General Staff College. MAJ Wehr holds a master's degree in structural engineering from the University of Texas, Austin, and is a licensed professional engineer in Virginia.

CTC Notes

Battle Command Training Program

1999 BCTP Perceptions for Mobility/Survivability

By Lieutenant Colonel Ron Light

Each year the Battle Command Training Program (BCTP) consolidates significant lessons learned as a result of Warfighter exercises. Developed for each battlefield operating system (BOS), these lessons learned become *BCTP Perceptions*. The 1999 BCTP Perceptions for the engineer portion of the mobility/survivability (M/S) BOS and some tactics, techniques, and procedures (TTPs) follow.

Perception: Commanders and staffs do not effectively use scatterable mine systems.

Discussion: Effective use of scatterable mines starts with a good plan. Staffs must synchronize scatterable mine employment within the M/S BOS and with other BOS. (See *Engineer,* March 1999, page 42, for a discussion on the orders crosswalk process, which is a technique to synchronize orders and plans.) Staffs continue to generate orders that do not address all scatterable mine systems. Moreover, the employment authority for scatterable mines in Annex D (Fire Support), Annex E (Rules of Engagement), Annex F (Engineer), and Annex M (Deep Operations) often differ.

A second concern regarding scatterable mine systems is the use of long-duration (more than 4 hours) scatterable mines. We typically see Corps restrict the division countermobility effort to only scatterable mines and provide only 4-hour scatterable mine authority. When Corps gives a division 24 hours to prepare for the defense but only 4-hour scatterable mine emplacement authority, *the division effectively has only 4 hours to execute the countermobility component of the defense.* Since divisions increasingly must rely on scatterable mines to provide all of their battlefield countermobility, long-duration scatterable mine emplacement authority is needed to give division commanders the flexibility to build their defense.

TTPs:

- Staffs must synchronize orders and plans; the orders crosswalk process helps units achieve synchronization.
- Staff officers should make it a habit to delineate emplacement authority for *all* types of scatterable mines in plans and orders.
- Staff officers should consider putting authority for scatterable mines in the engineer paragraph of the base order and not repeat it in Annex D (Fire Support), Annex E (Rules of Engagement), or Annex M (Deep Operations). The fact that engineers are the proponent for countermobility is a cogent argument to do so. This technique also will reduce the size of orders and lead to greater synchronization.
- In BCTP-generated orders, divisions are given 48-hour scatterable mine emplacement authority so staffs can train with this capability. During home-station training, units should make it a point to push obstacle emplacement authority down to the lowest sensible level.

Perception: Neither the G2 nor the engineer S2 continuously template enemy countermobility efforts.

Discussion: Most staffs initially template enemy engineer efforts: They know what capabilities enemy engineers possess, calculate the total amount of countermobility effort the enemy can undertake in a given time period, and relate enemy engineer efforts to locations of enemy maneuver units on the battlefield. Thus, most divisions have a good idea of enemy countermobility efforts as they cross the line of departure (LD). However, maneuver units often are surprised by the number of obstacles they encounter as they attack through the enemy's security zone and into the subsequent first and second main defensive belts.

The problem is that *staffs stop templating enemy countermobility efforts after units cross the LD, while enemy engineers continue to build the defense after friendly units begin their attack.* Staffs rarely update the enemy template with additional enemy countermobility efforts. Additionally, enemy engineer countermobility efforts, as templated by the G2 and the engineer S2, often differ significantly.

TTPs:

- Division engineers must educate commanders and staffs that the enemy's countermobility effort is continuous and update the enemy template as necessary.
- The engineer S2 and the division G2 must train together to build consensus on enemy engineer capabilities.
- The division engineer should distribute information regarding templated enemy countermobility efforts at regular intervals, perhaps every 6-8 hours. One division engineer provided this sort of update twice daily—during the division commander's battle update brief (BUB).

Perception: Commanders do not maximize countermobility capability or effects.

Discussion: This perception has four components:

- Division commanders do not specify an overarching concept for the defense, and not all division engineers are weighing in to correct this deficiency. Staffs produce orders that lack graphics (showing obstacle effect intents, obstacle zones, and belts) and text (in the concept of operation or scheme of maneuver paragraphs) that explains where the commander wants to kill the enemy, how he intends to make the enemy go there, what he will do if the enemy does not go there, and who will do the killing.
- Commanders fail to use obstacle-control measures to focus engineer effort and materials. (See *Engineer*, July 1998, page 28, for a discussion on the use of obstacle effect intent graphics.) When commanders do not articulate their vision for the defense—through graphics or narrative—the usual outcome is a series of separate, unsynchronized brigade-level fights that the enemy handily defeats one at a time, at a time and place of his choosing.
- Some commanders and staff do not address obstacles or obstacle control measures in support of offensive operations. The creation of obstacle zones during offensive operations is a doctrinal method to synchronize countermobility operations during an attack, and it helps focus staff planning for the defense when the attack culminates. It is very hard to implement obstacle zones after units have crossed the LD. Successful units plan countermobility operations during the offense.
- Staffs continue to struggle with battle tracking, partly because of the massive volume of information collected. At division level, staffs must reduce the information they collect and manage to what's important. This is often driven, at least in part, by the commander's critical information requirements (CCIR). What are the key pieces of information required for a specific operation? Requirements vary, but information regarding friendly and enemy obstacle locations and friendly and enemy breaching are common to both offensive and defensive operations. While engineers often talk about "focusing the intelligence effort," staffs and commanders must focus the reporting effort. (See *Engineer*, November 1998, page 36, for a discussion on ways to improve staff command and control and reporting).

TTPs:

- Although this requirement is optional in doctrine, staffs should always specify obstacle zones and intents for the defense and offense to the extent that it makes tactical sense to do so.
- Ensure that the tactical plan specifies the where, how, who, and what elements of a defense, as discussed above.
- Reduce the frequency and scope of reporting. For example, is it really important to know when a particular obstacle belt is 25-, 50-, or 75-percent complete, or are initiation and completion reports sufficient? (See FM 90-7, *Combined Arms Obstacle Integration*, Appendix B.) Tie reporting to CCIR whenever possible.

Perception: Engineers participate in deep target planning, but the results are mixed.

Discussion: Engineers are part of the deep targeting process according to doctrine. This means that engineers should integrate their knowledge of terrain, obstacle effects, scatterable mine employment, and enemy engineer mobility/countermobility capabilities in the functions of the deep operations coordination cell (DOCC). They should not attempt to arbitrarily place GATOR missions on the Air Tasking Order. Engineer staff officer functions in the DOCC will usually include—

- Understanding which enemy engineer systems are high-value targets and recommending that they be added to the high-payoff target list.
- Recognizing that terrain and infrastructure (such as bridges or built-up areas) influence enemy mobility and recommend they be targeted specifically to affect enemy mobility. Remember that friendly mobility may be affected later: infrastructure destruction is a two-edged sword!
- Advising the DOCC on the effects and limitations of scatterable mines.

(Continued on page 60)

ENGINEER UPDATE

ommercial numbers are (573) 563-xxxx and Defense System etwork (DSN) numbers are 676-xxxx unless otherwise noted.

Directorate of Training Development (DOTD)

Total Army School System (TASS) Battalion Schools. ***Correction:*** The August issue f *Engineer*, pages 63-64, reported that the Engineer School's Multimedia Division is orking on the distance learning portion of the 63E10 Reclassification Course. The update em should have read "62E10 Reclassification Course."

POC is Terry Tapp, -4116.

Field Manual Update. The following field manuals (FMs) are scheduled for publication:

- FM 5-34, *Engineer Field Data*, has a print date of 30 September 1999. The Army Training Support Center (ATSC) anticipates distribution about mid-November. This FM is posted to the Engineer School's Publications Page *(http://www.wood.army.mil/PUBS/newpubs.htm)*.
- FM 20-3, *Camouflage, Concealment, and Decoys*, was distributed with a print date of 30 August 1999. It is posted to the ADTDL at *http://155.217.58.58/atdls.htm.*
- Change 1 to FM 20-11, *Military Diving*, and Change 3 to TC 5-400, *Unit Leader's Handbook for Environmental Stewardship*, are at ATSC awaiting printing and distribution. They are currently available on the Engineer School's Publications Page (address above).

POC is Sandra Gibson, -4100

Engineer Personnel Proponency Office (EPPO)

Annual Engineer Awards. Engineer units across the Army are documenting their ctivities in a book to submit for the annual Itschner, Stargis, and Grizzly award competition. ased on these submissions, the best engineer company, NCO, and platoon leader are elected from each Army component—active, National Guard, and reserve—and will be ecognized at Fort Leonard Wood during the annual ENFORCE Conference in April.

To meet the 10 February 2000 deadline to EPPO, units should begin planning early. lmost every year some unit's presentation is disqualified at some level of competition for eing submitted late. Allow time for the books to be checked at the unit level for such things s spelling, grammar, and content; and ensure that recommendation letters are signed on ime at the appropriate level.

USACE sends out a message in October with instructions for award submissions for that ear. The message, along with examples from units' previous submissions, provides nformation for preparing this year's submission. The EPPO at Fort Leonard Wood works ith USACE to administer the Engineer Awards Program by receiving the books, setting up he selection board, and obtaining plaques for the winners.

POC is SGM Rather, ratherj@wood.army.mil, or –7232.

News and Notes

U.S. Army Military Academy Preparatory School (USMAPS). Each year approximately 200 Regular Army soldiers are offered admission directly to the U.S. Military cademy (USMA) at West Point, New York, or to the USMAPS at Fort Monmouth, New ersey.

USMAPS prepares soldiers for success at USMA through an intensive curriculum ocused on English and mathematics. Applicants must be U.S. citizens, unmarried with no egal obligation to support dependents, high school graduates, under age 23 on 1 July of the ear they enter USMA (under age 22 before 1 July of the year they enter USMAPS), of high oral character, and must have a sincere interest in attending USMA and becoming an rmy officer.

Soldiers who meet the basic eligibility requirements, have achieved SAT scores greater han 1,000 or ACT composite scores of 20 or higher, and have achieved good grades in ollege preparatory high school curriculum are especially encouraged to apply. Application equirements must be met by 1 April 2000 to be considered for an appointment to USMA or SMAPS in July 2000.

POC is MAJ Rob Young, tr9618@westpoint-emh2.army.mil, DSN 688-5780, or ommercial (914) 938-5780.

Farewell

It has been a privilege for me to serve as Engineer's editor for the past 11 years. I thank you for your outstanding support during this period and hope that you will continue to support the magazine in the years ahead. Your willingness to share your ideas and accomplishments through letters, notes, and articles is critical to the success of Engineer, and I encourage you to keep sending them.

In the first issue of Engineer, in the spring of 1971, MG Robert Ploger, Commandant of the U.S. Army Engineer School, expressed his commitment to the magazine. He viewed Engineer as "...a forum to air ideas on current engineering problems." He hoped that the magazine would trigger engineer thinking and stimulate discussion on controversial subjects. MG Ploger wanted to "...provoke the thought processes of the complete span of our personnel, from young enlisted men to career-oriented engineer officers. From them may well emanate new ideas, fresh approaches to existing problem areas—solutions, perhaps, to many of the technical barricades facing us."

Since that first issue, Engineer's staffs have faithfully followed General Ploger's sound advice. The challenges facing the Engineer Regiment have changed over the years, as have members of the magazine's staff, but our commitment has remained the same. Today our readers include Navy, Marine, and Air Force engineers, as well as allied engineers, and we welcome their input. As I retire from the Engineer Regiment, I extend my thanks to MG Flowers and many others for their strong commitment to the magazine. My thanks and best wishes to you all—I wish you well.

Catherine Eubanks
Editor

(Continued from page 58)

TTPs:

- Strengthen your recommendations for the high-payoff target list with analysis of the effects of enemy engineer systems. For example, does the division commander want to kill countermobility systems now or breach minefields later?
- With respect to GATOR scatterable mine munitions, staffs must understand that the Air Force prefers that we specifiy a target, an effect on the target, and duration of the effect, rather than specify the type of munition. Unless you are familiar with all the munitions available to the Air Force, leave munition selection to the Air Force Liaison Officer.
- Remember that the Air Tasking Order cycle normally is 72 hours long, which means that engineer staffs must predict and analyze enemy intentions 72-96 hours out. This kind of analysis is difficult to do at the division level. Recognize that your nominations on the Air Tasking Order will compete with all other nominations for air support within your theater of operations.
- Remember that the most effective obstacle is easily bypassed if not overwatched and covered by fires. Plan for and synchronize overwatching fires. Otherwise, ask yourself if the risk to the pilot you want to send deep into enemy territory is worth the potential effect on your target.
- Exercise caution when your success is based solely on the effects of deep operation.

Conclusion

The 1999 BCTP Perceptions represent cumulative lessons learned during Warfighter exercises by brigade and division commanders and their staffs throughout the Army. We hope that these mobility and survivability perceptions will assist units in honing their warfighting skills.

Lieutenant Colonel Light is the senior engineer observer/controller for the Battle Command Training Program at Fort Leavenworth, Kansas. He is scheduled to command the Honolulu District, U.S. Army Corps of Engineers, in July 2000.

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Lead the Way

By Command Sergeant Major Art Laughlin
U.S. Army Engineer School

Competence, Confidence, and Dedication to Duty

Command Sergeant Major Riddle, 9th Engineer Battalion, stepped out of his HMMWV in Kosovo and deliberately unfurled his battalion colors. As he did this, he simply stated, "I want everyone here to know we are going to make a difference!" His statement reflects the attitude of our Engineer Regiment—officers, noncommissioned officers, and soldiers alike. It's a true reflection of our regiment today. Engineers from across the world bring that same attitude to Kosovo every day. These engineers, who are part of Task Force Falcon, are transforming a one-time wheat field and grassy plain into a forward-deployed operating base.

Underlying CSM Riddle's statement is an understanding of the keys to engineer success: competence, confidence, and dedication to duty. Members of our regiment demonstrate their skills in these areas every day, and Task Force Falcon is an excellent example. This arena gives us an opportunity to show our fellow comrades-in-arms what engineers can do. Peacekeeping missions by our sappers and construction work by our combat heavy soldiers assist the local populace in building a new way of life and enable us to provide an environment from which to sustain Task Force Falcon at Camp Bondsteel. (See article, page 8.)

Competence starts with the willing desire of our soldiers to want to be the very best at what they do. This desire reflects directly on the NCOs who lead these soldiers every day—on the leaders who teach, train, and motivate them. Competence means that soldiers know what to do and how to do it. Competence means that NCOs know how to use those competent soldiers to enable units to complete the myriad of tasks required to get the mission accomplished.

Confidence comes to a soldier who is competent in all he or she does. A unit becomes confident when it performs to standard in all it is required to do. The regiment's confidence also comes from the demonstrated performance of units in training and operations. CSM Riddle unfurling his battalion's colors and making his statement was no boast. Instead, he expressed the confidence he has in the regiment and in those with him in Kosovo.

Dedication to duty is a trait of the American soldier. Our soldiers will accomplish what needs to be done in spite of challenges. This trait is particularly evident in engineers. I recently saw the dedication shown by sappers of the 9th Engineer Battalion as they performed peacekeeping operations while working with the local population in Kosovo. I lived this sense of duty with the 94th Engineer Battalion; A Company, 864th Engineers; and the 568th Combat Support Equipment Company while construction efforts were ongoing in Camp Bondsteel. Our dedication to duty is obvious in this operation.

As the Engineer School's command sergeant major, I have the job to keep our regiment competent, confident, and dedicated. Now, more than ever before, we must be the masters of our trade. We must make time available to do self-study. We must refresh ourselves with knowledge so we can guarantee success the first time. I once heard a sergeant remark that it seemed as though we always have enough time to do it right the second time. Why not take the time to do it right the first time?

It is my sincere desire to continue serving the regiment whenever and wherever necessary. I will seek your expertise across the field to ensure that we in the schoolhouse are in touch with your needs. Together we will build on individual competence and unit confidence. Together we will be better able to support our Army into the future. As your concerns or needs arise, feel free to contact me at the following e-mail: Laughlia@wood.army.mil. Or, call commercial (573) 563-6192.

In closing, I remind all engineers of the importance of integrating risk assessments in all that we do. Too often a proper risk assessment is overlooked or forgotten. When that happens, our soldiers' safety is put in jeopardy. Perhaps we need to think about the pain that fellow soldiers go through when we forget a risk assessment. Every one of us in the Army must look out for one another. It is our business as NCOs and officers to be sure that we protect America's most precious resource—her sons and daughters. I challenge each of you to be continually vigilant in safeguarding one another. Don't allow a shortsighted moment to become a lingering bad memory. This is a lead-from-the-front responsibility only. There is no room for a second chance. Stay safe!

I am honored to serve the regiment as the Engineer School's command sergeant major. I accept the duties willingly because of my great confidence in our regiment and my desire to build upon the outstanding legacy of CSM Dils.

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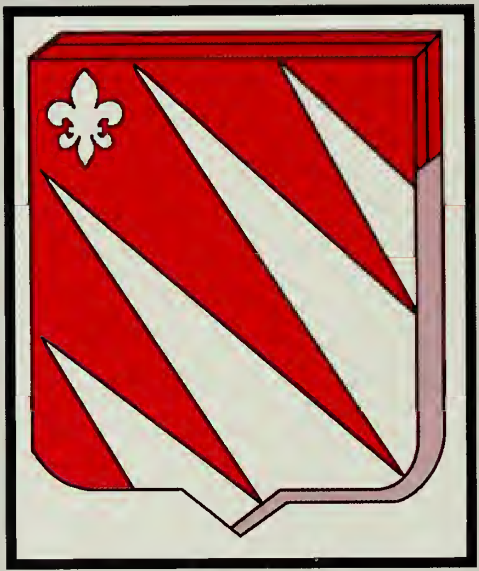
ARMY VALUES

Personal Courage

"They are surely to be esteemed the bravest spirits who, having the clearest sense of both the pains and pleasures of life, do not on that account shrink from danger."

Thucydides - The Peloponnesian Wars



The 48th Engineer Combat Battalion Presidential Unit Citation

As a part of an engineer combat group, the 48th "...was assigned the mission of opening and maintaining axial supply routes for a task force assault to capture and occupy an enemy mountain stronghold (Mt. Porchia, Italy) during World War II. The 48th Engineer Combat Battalion not only performed its normal engineering tasks under fire from a fiercely resisting enemy but also attacked as infantry during bitter fighting to secure the objective. During the engagement, a gap developed on the left flank of the task force and the engineers courageously fought to secure this flank and prevent enemy penetration. As the attack progressed, infantry losses were severe, as all reserves had been committed to action in an effort to destroy enemy resistance. All companies of the 48th Engineer Combat Battalion were then committed to action as infantry in the final and successful assault to drive the enemy from task force objective."

Members of the 48th received one Medal of Honor (SGT Specker), three Distinguished Service Crosses, and 22 Silver Stars.

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